GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

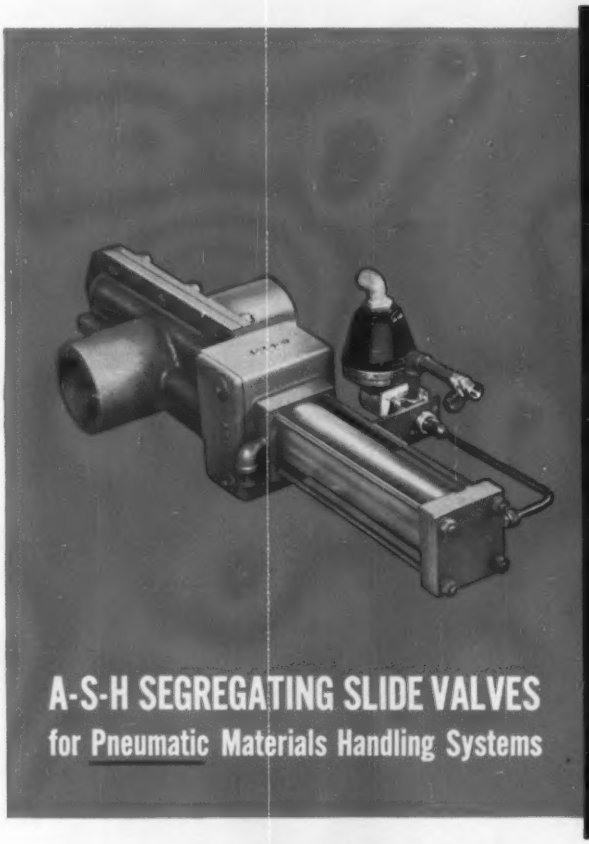
NOVEMBER
1956 • 50¢

Power to grow ...electrically

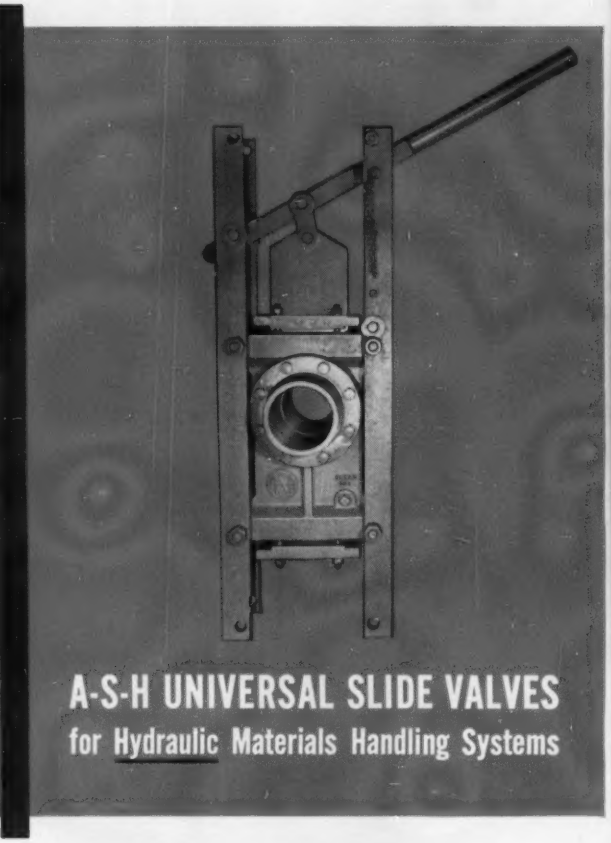
Today's big must for commercial buildings:

p 75

Specify these A-S-H MATERIALS HANDLING VALVES



A-S-H SEGREGATING SLIDE VALVES
for Pneumatic Materials Handling Systems



A-S-H UNIVERSAL SLIDE VALVES
for Hydraulic Materials Handling Systems

For completely unrestricted flow, leak-proof shut-off, clog-free operation

A-S-H Materials Handling Valves are designed to sectionalize or isolate portions of your pneumatic or hydraulic materials handling systems. For *pneumatic* materials handling systems, choose an A-S-H Segregating Slide Valve. For *hydraulic* materials handling systems, choose an A-S-H Universal Slide Valve. Both valves permit sectionalization of the piping system to direct the flow through the desired course.

A-S-H Materials Handling Valves offer several important design and operating advantages over flap and rotary types:

Unobstructed Flow—There is no "necking down" in the interior of these valves. Slide gate opening, same size as pipe diameter, gives completely unrestricted flow.

Leak-Proof Shut-Off—These slide valves are the only type that can be depended upon to eliminate leakage past the gate because the seat is always protected. Slide gates are held tightly against seat either by vacuum, in pneumatic systems, or pressure, in hydraulic systems, thus assuring a positive seal.

Clog-Free Operation—In pneumatic systems, the vacuum keeps the clearance spaces around the slide gate free of clogging material. In hydraulic systems, the water pressure keeps the clearance spaces flushed clean.

Both valves are designed for manual or power operation. And both are precision made of corrosion resistant materials. The Universal Valve is available in 6, 8 and 10-in. sizes. The Segregating Valve comes in 4, 5, 6, 8, 10 and 12-in. sizes. Full details are yours for the asking. Write for Data Sheet Ua on A-S-H Segregating Slide Valves or Data Sheet Ub on A-S-H Universal Slide Valves.

The **Allen-Sherman-Hoff** Company

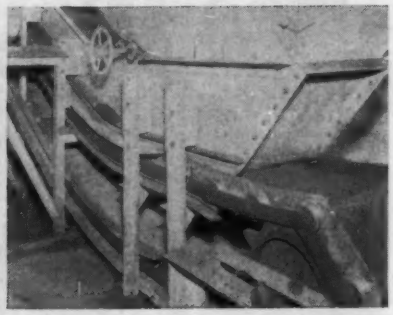
259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

MATERIALS HANDLING SYSTEMS
hydrojet *hydraulic* / **hydrovac** *pneumatic*

For all sizes of power plants--

ROTARY DUMPERS unload gondola cars in 90 seconds or less (including return to upright position). Handle all types of open-top cars up to 90-ton capacity.

LINK-BELT CAR SHAKER is easier on cars, thanks to exclusive low-frequency vibration. Noise level is lower. Positive action cleans hopper-bottom cars fast.

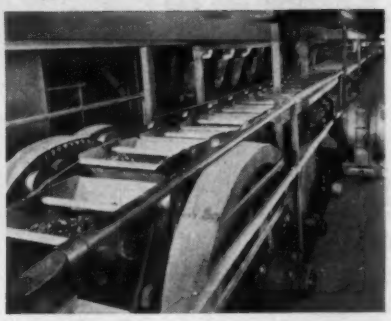


APRON FEEDERS move coal horizontally or on inclines up to 25° from hoppers or bins in continuous, uniform flow. Rugged overlapping pans resist impact.

LINK-BELT equipment and engineering...

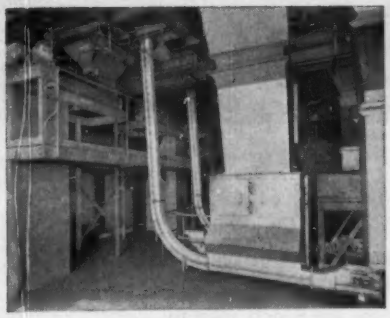
BELT CONVEYORS handle large tonnages at low cost—stock out, reclaim, distribute. Link-Belt also builds all types of idlers, terminal machinery, trippers, etc.

BUCKET ELEVATORS offer flexible, low-cost handling. Link-Belt elevator shown discharges to silo and also handles coal to and from reserve ground storage.

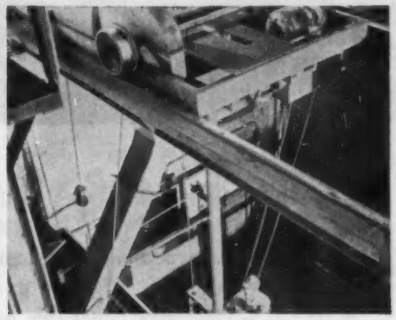


PECK CARRIERS, used in many coal handling systems for the last 60 years, elevate and convey coal in a continuous flow without the need for transfers.

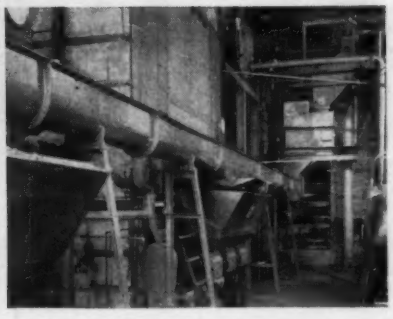
spell lowest per-ton handling costs



BULK-FLO combines functions of conveyor, elevator and feeder in a single unit of high capacity. Above, coal is delivered to crusher for continuous sampling.



WEIGH LARRIES automatically weigh and record amount of coal delivered to each stoker or bunker. Link-Belt offers motor or hand-propelled types in all sizes.



SCREW CONVEYORS provide economical distribution of coal to stoker hoppers. Link-Belt can supply all components—screws, troughs, hangers, drives, etc.

You'll be interested in Book 2410. Its 44 pages of photographs and drawings include many outstanding Link-Belt coal handling systems, large and small. Your nearest Link-Belt office has your copy.

LINK-BELT

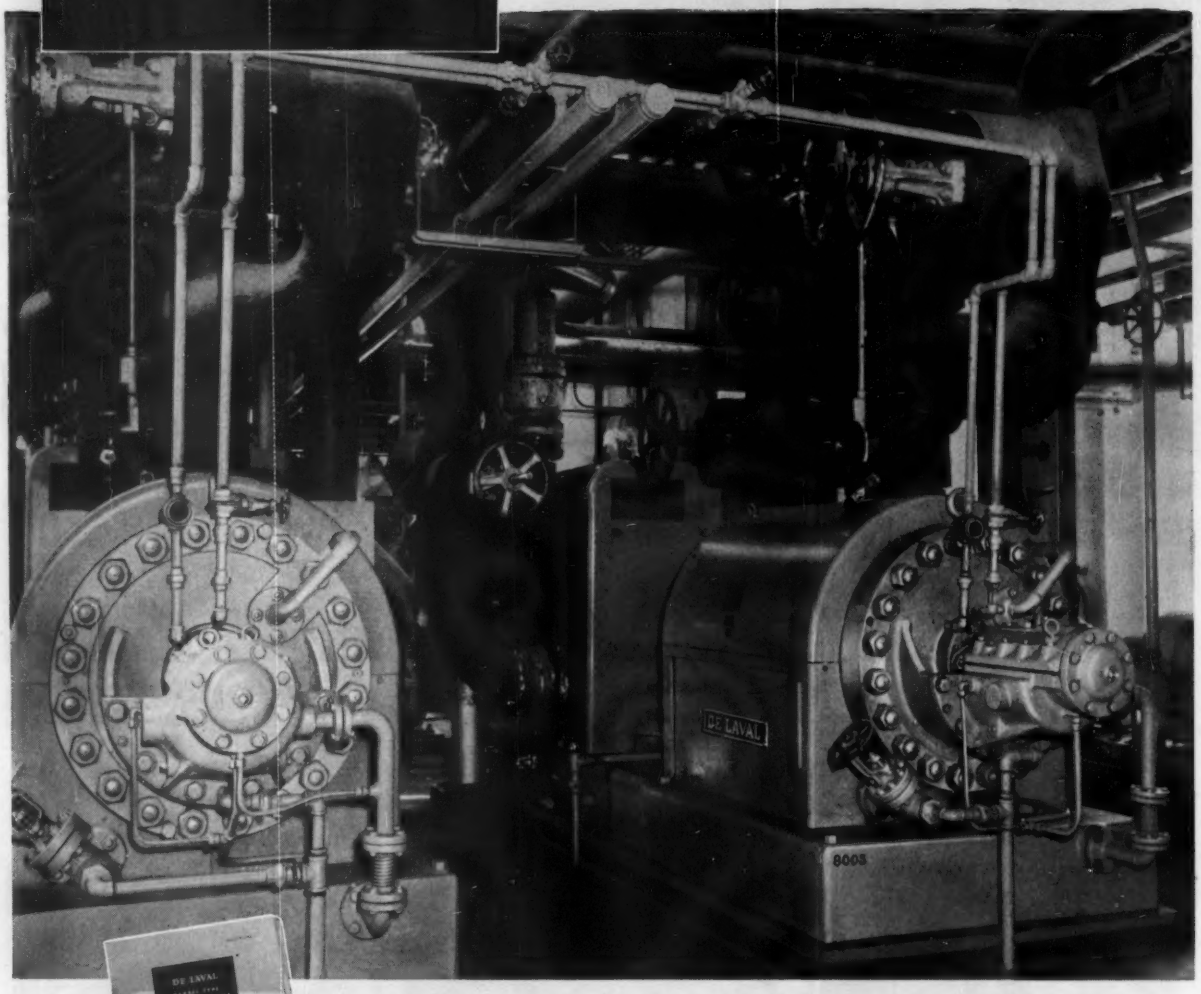
COAL HANDLING EQUIPMENT

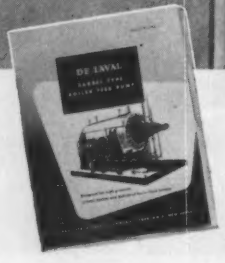
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

14 327

DE LAVAL
BARREL TYPE BOILER FEED PUMPS

give dependable service at Gaylord Container





Bulletin contains helpful data

Bulletin 1506 on the De Laval barrel type boiler feed pump covers all major design points... has cross-section cutaway illustration for easy reference. Write for your copy.

Here's additional proof of De Laval reliability on the line in the Bogalusa, La. plant of the Gaylord Container Corporation. These two De Laval barrel type boiler feed pumps are both driven by De Laval MCP turbines operating at 850 psi, with steam temperature at 825 F.

• De Laval barrel type boiler feed pumps are widely used by industrial plants and public utilities. They operate at pressures up to 5,500 psi. These units offer many important design advantages, such as double volute diaphragm, individual diaphragm bolting, positive sealing between suction and discharge chamber and bare shaft construction. Their dependability is proven by year-in, year-out service.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL 338

Power

NOVEMBER 1956 • VOLUME 100 NUMBER 11

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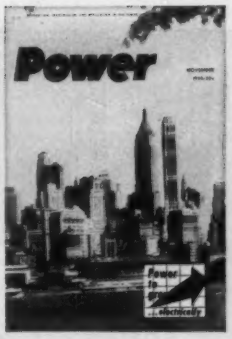

POWER TO GROW . . . electrically moves into the commercial-building area this month. POWER editors select New York City for the case-in-point, find the squeeze for additional power here even more pressing than in many industrial plants. And getting that power to upper floors is a problem of major proportions. To see how it's being done, turn to page 75.

Next month . . .

Lubrication Notes, a hard-hitting series on practical problems faced in plant lubrication, gets a December kickoff. It's not a review of lube theory, but rather a collection of field-findings by a seasoned lubrication engineer, based on actual plant experiences.

Fractional-hp motors are called upon to do a big industrial job. They're found in varying numbers throughout every plant. Problems related to their selection, connection and application get the full editorial treatment in next month's *Plant Electrical Fact File.*

Telescope and mirrors now give a true alignment check while machinery is hot and running. Technique, developed by Con Edison of New York, pays off in reduced maintenance, less downtime. Coming 3-pager has all the facts and figures.

. . . and future months

Radioactive isotopes are rapidly finding new uses in plant maintenance and other industrial applications. Just how are they used? What are the dangers involved? Associate Editor Steve Elonka is busy laying the groundwork for a roundup article—watch for it.

NOVEMBER 1956 POWER Vol. 100—No. 11

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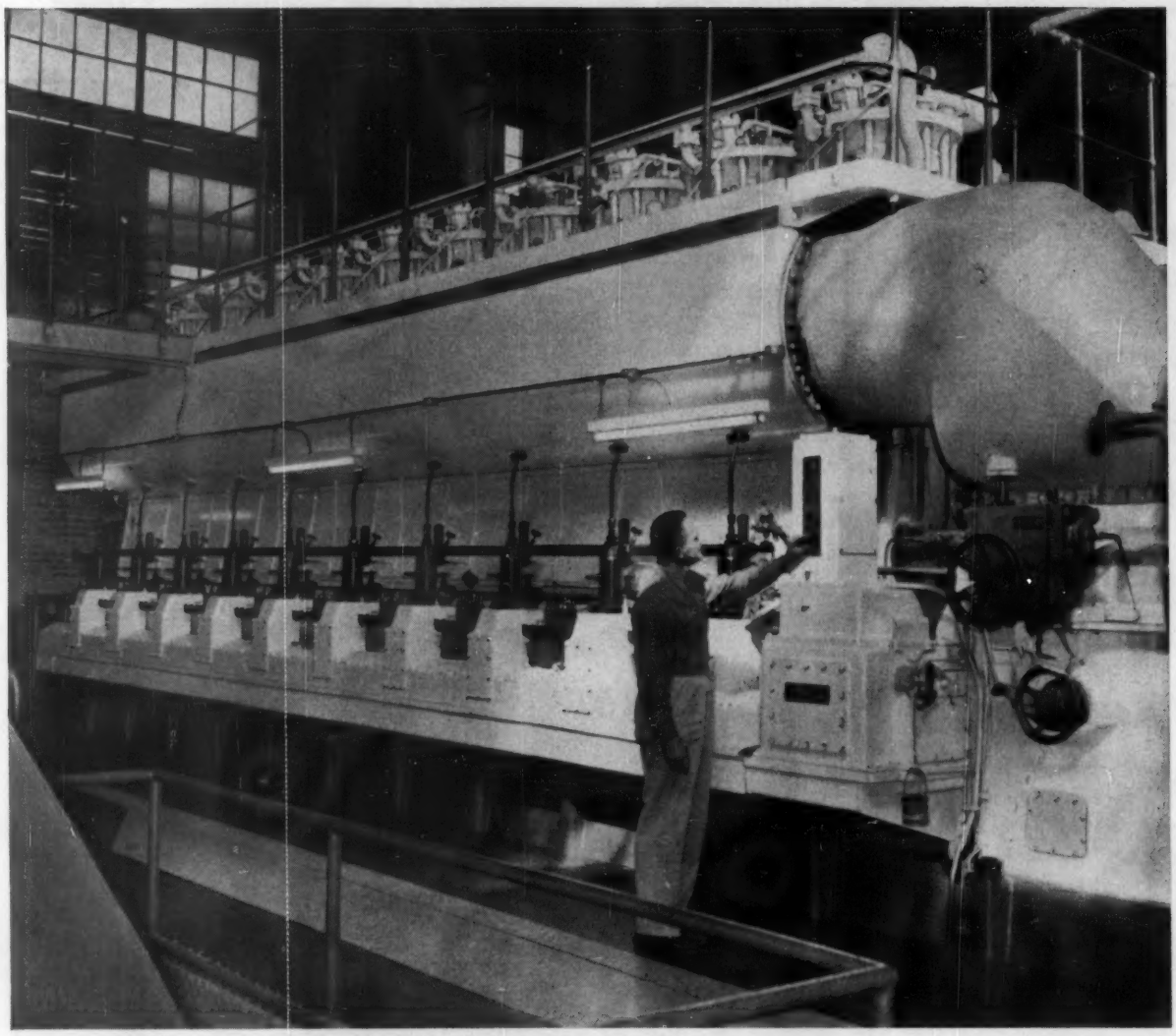

Raise power output ...reduce costs

IT CAN BE DONE . . . when you change the lubricant in your engines to one of the famous *Texaco Ursa Oils*. Because *Texaco Ursa Oils* prevent harmful engine deposits, keep rings and valves free for full compression and combustion – you'll see power output go up, kwh costs come down.

There is a complete line of *Texaco Ursa Oils*—especially refined to assure *more power* with *less fuel* over *longer periods* between overhauls – from diesel, gas or dual-fuel engines.

This is no idle claim. It's backed by the fact that –

For over 20 years, more stationary diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.

Get in touch with a Texaco Lubrication Engineer soon. With his help in selecting the right *Texaco Ursa Oil* for your needs, you'll get a head start toward greater efficiency, lower costs.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

speaking of Power

AFTER 21 YEARS special-report reprints are still growing in popularity; now available in bound-volume form

Power's special reports: A firm foundation for tomorrow's growth

A reader bound for Arabia dropped into our office before starting out on his long-term foreign engineering project. He wanted to take, as reference, an assortment of POWER's special reports. And he wanted them book-bound for permanence. Result is shown above.

Special reports have been serving POWER readers' technical needs for the past 21 years. First report, *Piping*, was published in the February 1935 issue. Since then, some 750,000 reprints of published reports have been requested. In a recent 16-month period, well over 75,000 reprints were asked for by POWER readers. One manufacturer has a standing order for 25 copies of each special report as it appears. Biggest reprint orders to date have been for *Steam Turbines, Steam Generation and Feedwater Treatment.*

How are they used? Special reports in reprint form generally find their way to a prominent spot on an engineer's reference shelf. They're used as training aids for new men, refresher material for key people and in engineering schools as easy-to-read study aids.

Meeting a deadline is old hat in the publishing business, even when supplying reprints. When Union Oil Co on the West Coast asked for over 2000 copies of POWER's *Handbook on Bearings and Lubrication* we shipped them Railway Express on a Friday afternoon. Later that same day word came through that the reprints had to be on tap for a sales meeting in Los Angeles on Monday morning. We had to hustle to get more than 20 packages out of the express terminal and into a cab bound for LaGuardia Airport. They made it and in time.

Eyeing that bound volume in above photo? Then check our booth at the Power Show in New York's Coliseum, November 26 to 30. You may win one with your name imprinted in gold on the cover.

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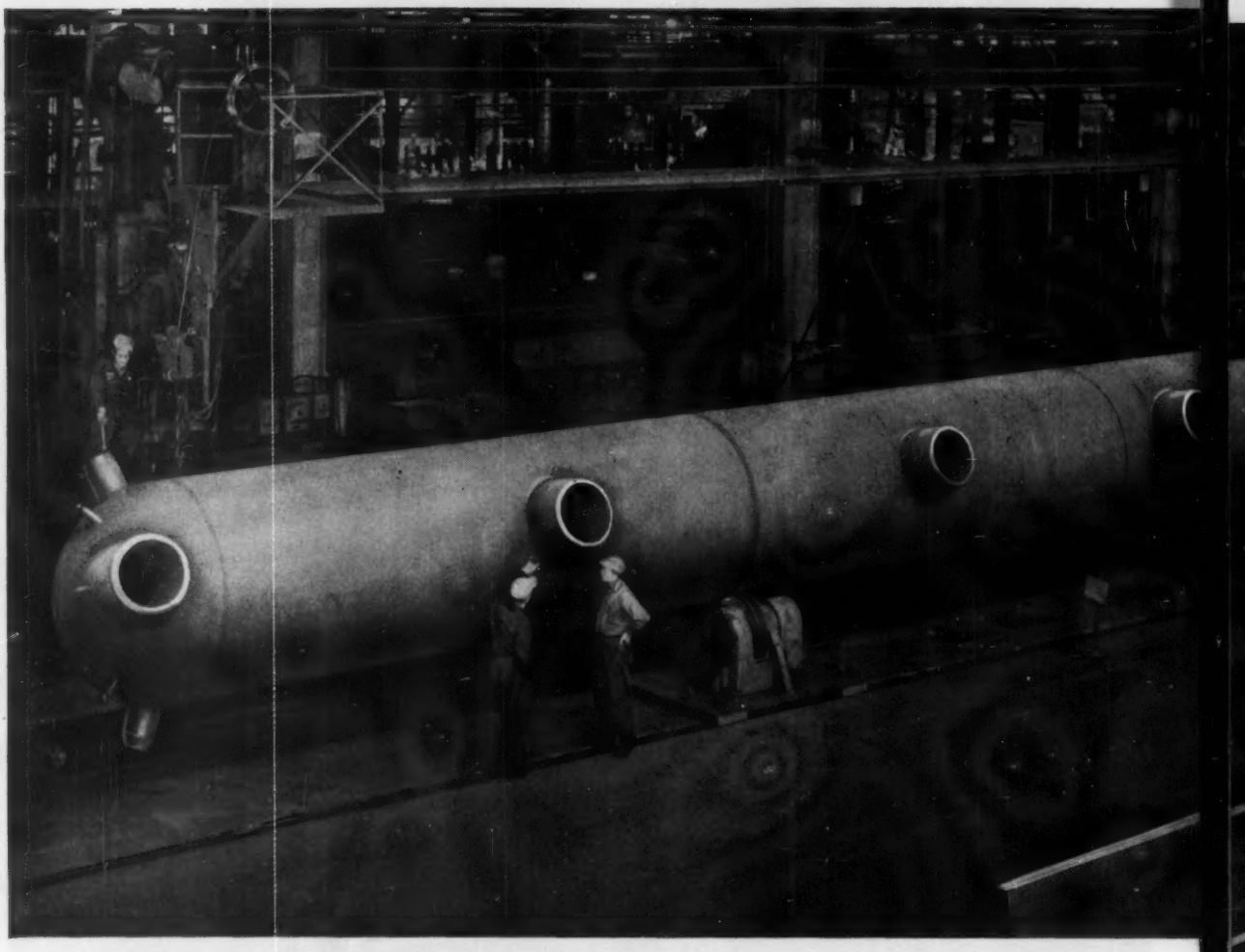


CONSTRUCTION IN HIGH

Two of the world's largest boilers for

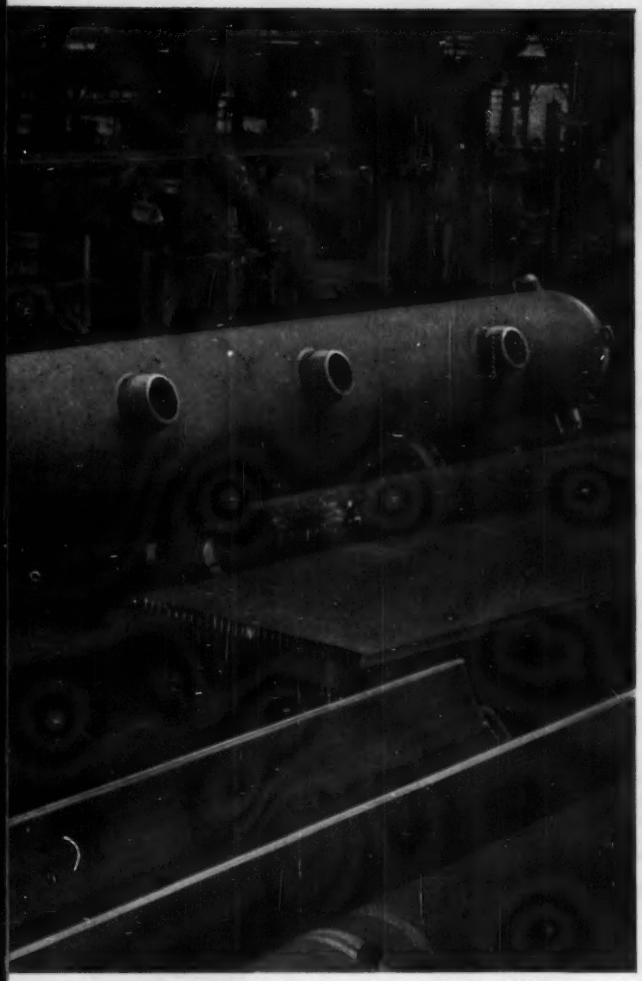
Keeping ahead of the world's greatest city is no easy task—but for many years "largests" and "firsts" have had to be the rule with New York's source of light and energy.

B&W furnished the first million pound per hour boiler for Con Edison's Hell Gate Station back in 1930. Many other engineering advances later accepted as standard in the industry have been pioneered on this system. For example, B&W furnished —for Con Edison's Astoria Station—the first pulverized-coal-fired pressurized boilers operating without induced draft fans.

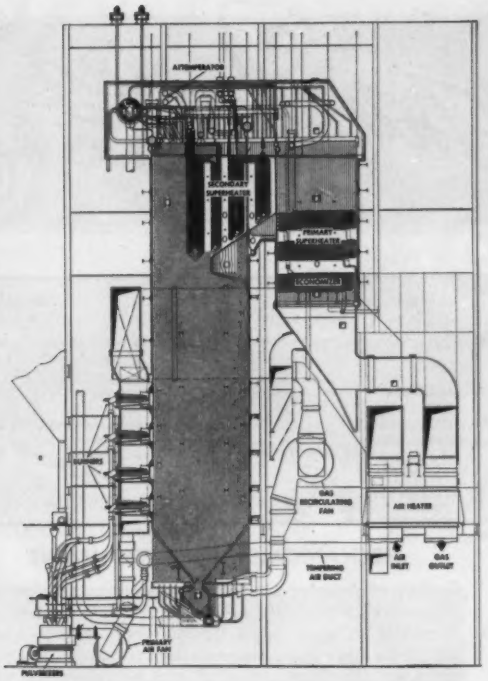
And now, this latest step: two huge B&W Radiant Boilers being built for Con Edison . . . right in line with Con Edison's long-standing policy of progressive engineering.

Each B&W Radiant Boiler has a capacity of 2,400,000 lb of steam per hr and features pressure-firing, natural circulation, and separate furnaces with a single steam drum. The unit for Astoria is the third pressure-fired B&W Boiler to be designed for this new modern station of the Con Edison System.

In all but size and design details, Con Edison's new boilers are typical of many other B&W units now providing dependable, efficient steam generation in central station and industrial plant service.



The world's largest boiler drum . . . over 100 feet long, 66 inches inside diameter . . . is shown in a finishing bay at the B&W Barberton Plant awaiting shipment to Con Edison. It weighs over 200 tons.



One of the two identical B&W units for Con Edison's Astoria and Arthur Kill Stations. It is a horizontally pressure-fired, coal-burning Radiant Boiler designed for dry ash removal. Type EL Pulverizers are used to permit reliable, efficient, direct-firing of pulverized coal. The unit has a design pressure of 2500 psi, steam temperature of 1050 F and reheat to 1000 F. The secondary superheater is located at the exit of one furnace, and the reheater at the exit of the other furnace. The primary superheater is back of both the secondary superheater and the reheater. The giant drum, with Cyclone Steam Separators for natural circulation, provides nearly 100% separation of steam from water.

GEAR AT CON EDISON

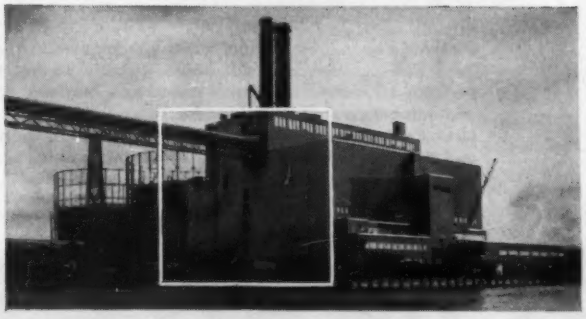
Astoria and Arthur Kill Stations

B&W engineering advances in terms of improved steam generation efficiency—under your fuel and operation conditions...are available to you. Write, The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.

G-813-CS

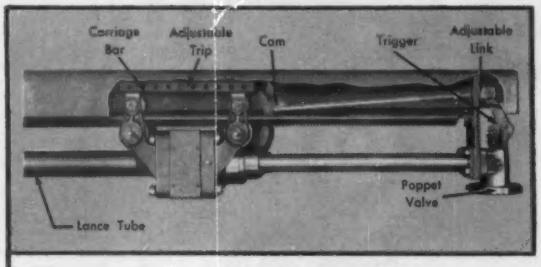
BABCOCK & WILCOX

BOILER DIVISION



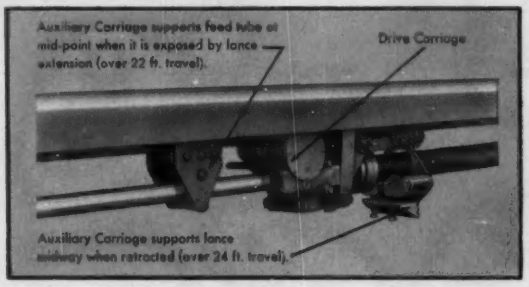
Area outlined in white shows construction area on third unit for Con Edison's Astoria Station.

Introducing DIAMOND SERIES 300 IK



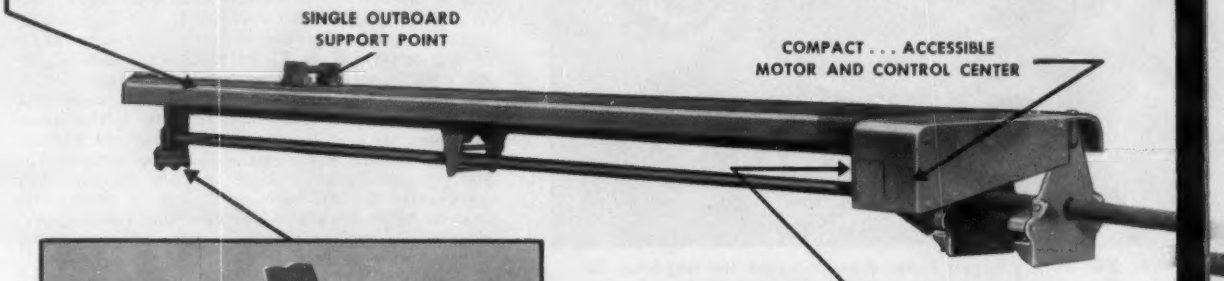
MECHANICALLY OPERATED VALVE

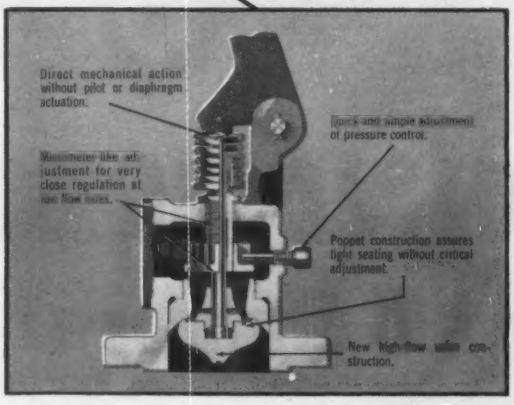
Control of blowing medium is automatic, positive and accurate by means of a simple, dependable mechanically operated valve. As lance begins movement into boiler, trip on carriage opens valve through a linkage. At end of retraction, trip closes valve. All pilot or diaphragm valve elements are eliminated. Trip is adjustable.


Auxiliary Carriage supports feed tube at mid-point when it is exposed by lance extension (over 22 ft. travel).
Drive Carriage
Auxiliary Carriage supports lance midway when retracted (over 24 ft. travel).

AUXILIARY CARRIAGES (FOR EXTRA LONG TRAVEL)

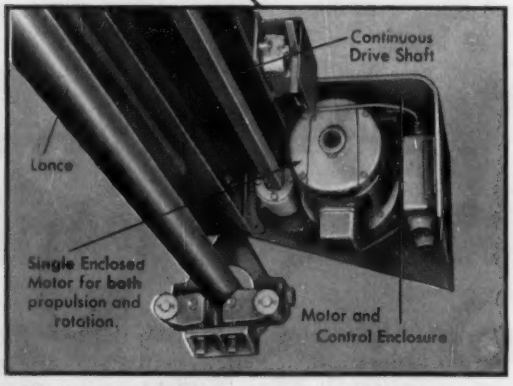
On extra long blowers, one auxiliary carriage supports lance midway when retracted, preventing undue bending. Second auxiliary carriage is dropped at mid-point to support feed tube when it is exposed by lance extension.




Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Quick and simple adjustment of pressure control.
Poppet construction assures tight seating without critical adjustment.
New high-flow valve construction.

POPPET VALVE WITH ADJUSTABLE PRESSURE CONTROL

Diamond dependable poppet valve with improved streamlined flow contours and adjustable pressure control that permits easy, accurate setting of pressure at individual valve and independent of other blowers. Poppet construction assures tight seating without critical adjustment. Stem, seat and disc are stainless steel. Stellited seating surfaces are available.



STATIONARY GEAR MOTOR

Lance propulsion and rotation are by a *single* enclosed gear motor which drives a continuous shaft running the full length of blower and providing power to carriage. This construction makes it possible to mount motor in a fixed position at the front end for better protection and accessibility.

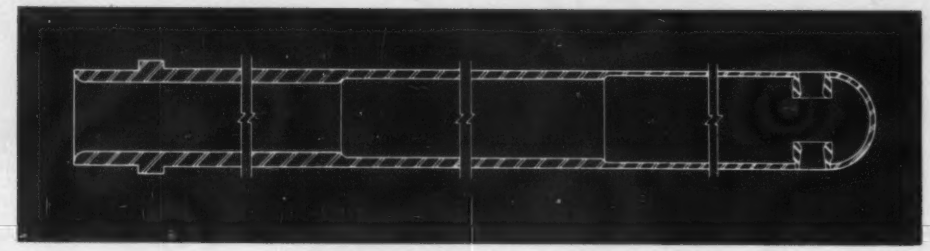
7594

DIAMOND POWER

LONG RETRACTING BLOWER

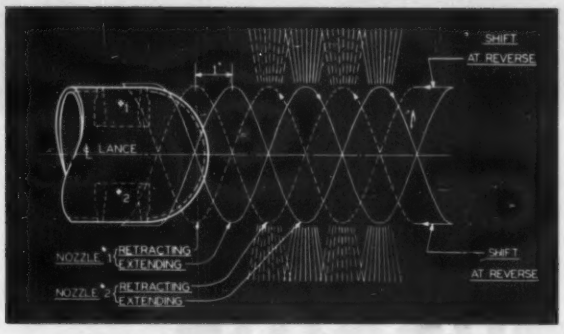
The Diamond Series 300 IK Blower sets a new and higher standard of efficiency, economy and dependability in the cleaning of heating surfaces that require a long retracting lance type blower. Pointed out in detail are some of its important features. Others are a *single* outboard support point to simplify installation and the attractive "backbone" cover for greater rigidity and protection of the entire blower assembly from dirt, damage, the elements and personnel hazards.

This new Series 300 IK is the culmination of more than 20 years' experience building and applying long travel blowers. It well illustrates the Diamond design philosophy: *"Keep it simple . . . keep it basic . . . avoid unnecessary complications."* It is further evidence of the fact that YOU CLEAN BOILERS BETTER AND AT LOWER COST WITH DIAMOND BLOWERS.



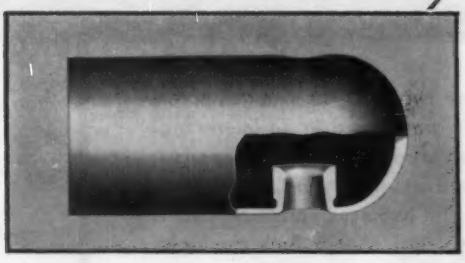
STEP-TAPER LANCE
(FOR EXTRA LONG TRAVEL)

Extra long lance has minimum droop due to step-taper construction which employs up to four different wall thicknesses. Lightest wall is at nozzle end to reduce bending moment. Lance is chrome alloy for heat resistance.



IMPROVE CLEANING PATTERN

Close and positively controlled helical cleaning pattern assures maximum cleaning effectiveness. Blowing pattern diagram illustrates how return travel path is exactly intermediate with forward travel path so that there is a *positive nozzle sweep every inch.*

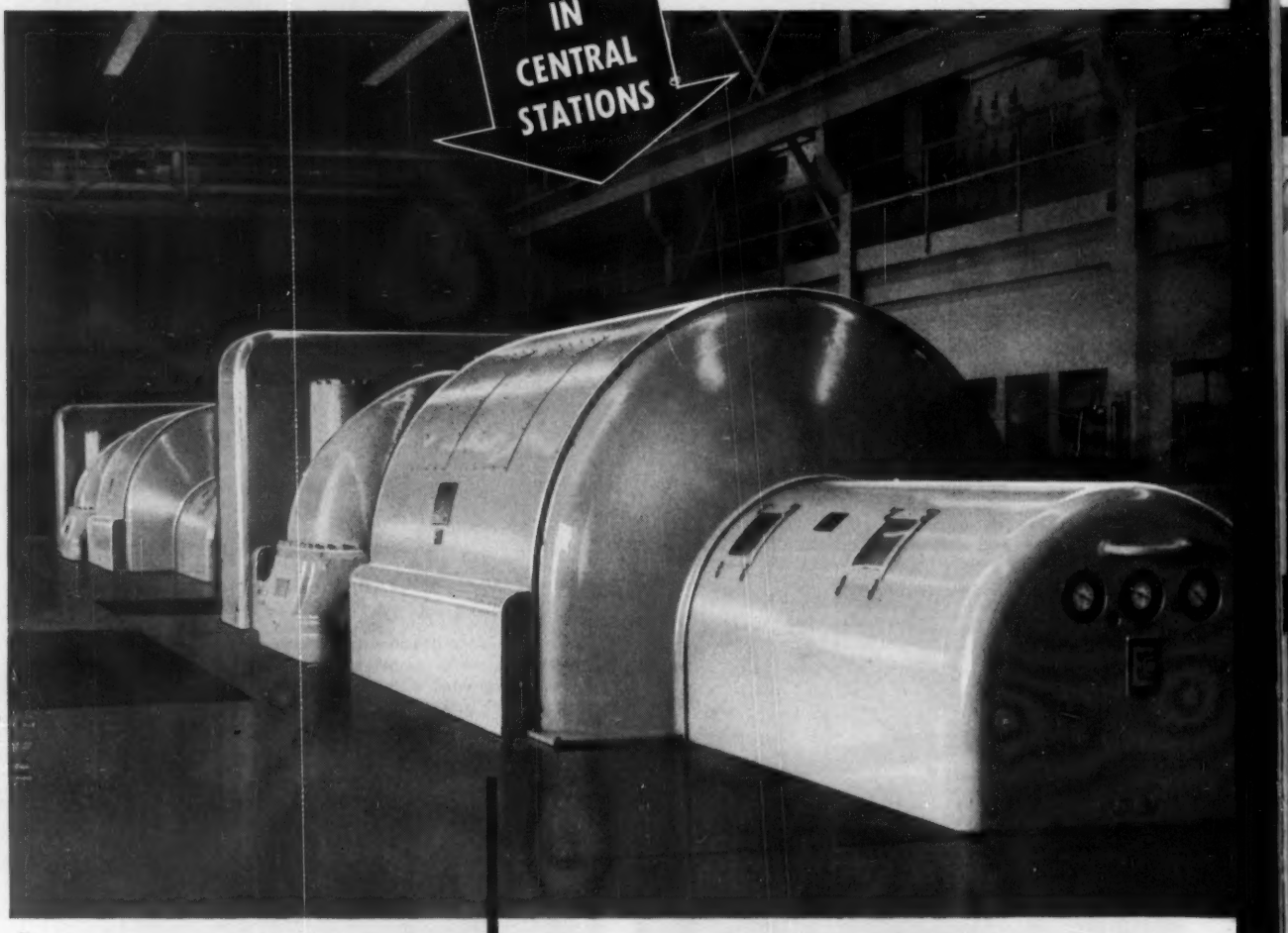


IMPROVED DIAMOND NOZZLE

New design Diamond "Type A" Nozzle is the result of several years' research and the testing of more than 50 different contours. The modified venturi produces maximum impact pressure and cleaning effectiveness with minimum expenditure of cleaning medium. (Steam or compressed air.)

SPECIALTY CORP. **LANCASTER, OHIO**
DIAMOND SPECIALTY LIMITED—Windsor, Ontario

Keeping pace with modern



These two Elliott turbine-generator units are located in an interesting new central station which was completed at a station cost of $139 per kw! The turbines operate on steam at 850 psi, 900°F. Both machines are base loaded, part of the power production being used for a local distribution system and the surplus sold as block power through a transmission interchange.

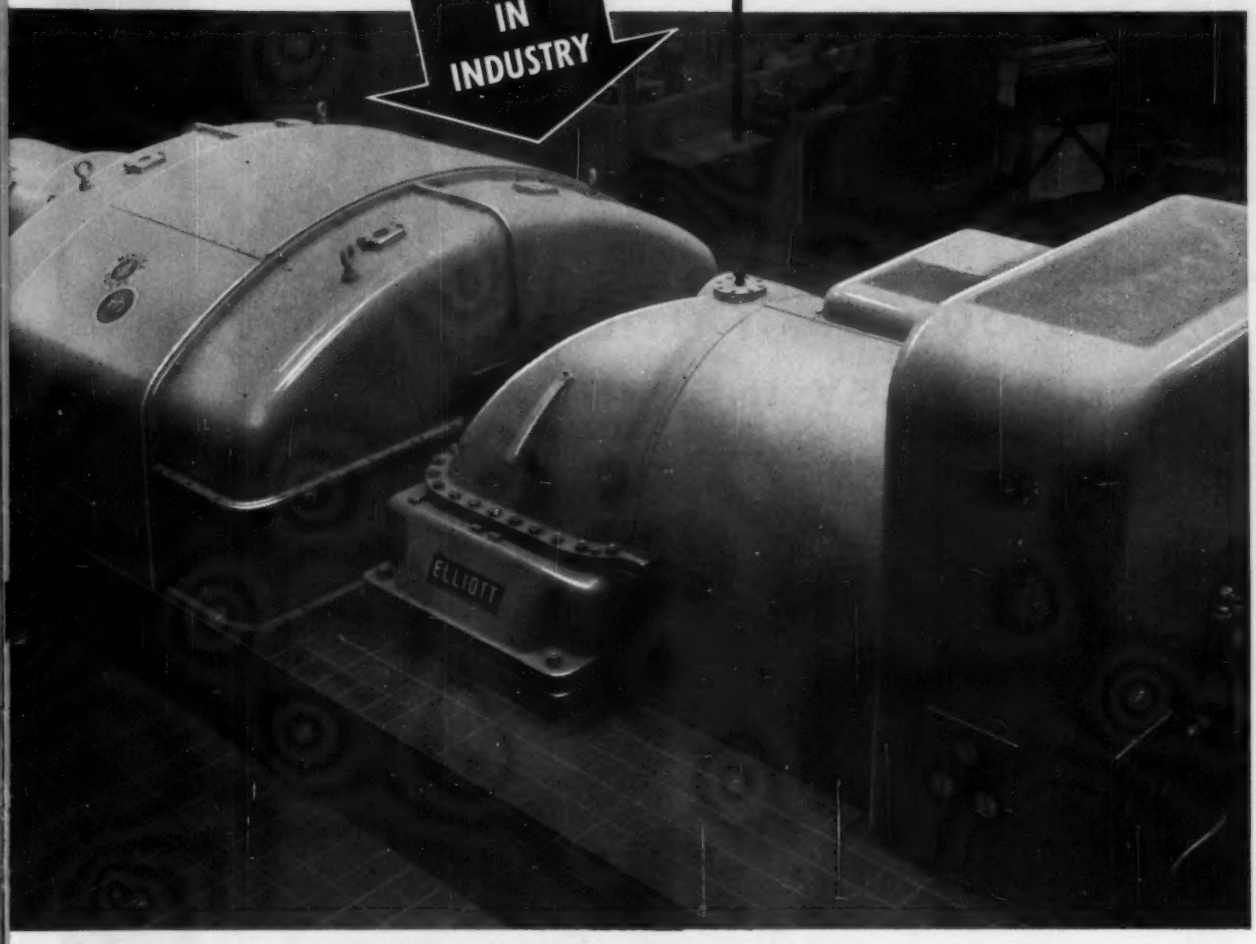
ELLIOTT TURBINE-GENERATORS

H4-B

requirements

IN INDUSTRY

This Elliott turbine-generator unit serves an industrial power plant. It extracts steam for process at 30 psig, being supplied with 400 psig, 700°F steam. This unit is an extension to an existing industrial power plant served by an Elliott back-pressure extraction unit.

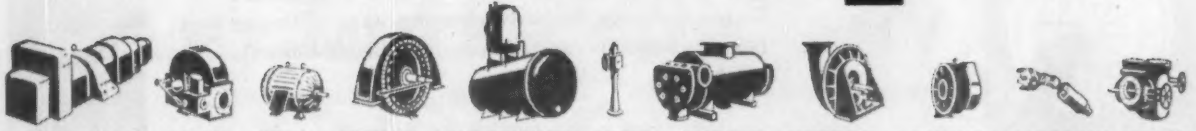


ELLIOTT TURBINE-GENERATORS meet the requirements for efficient power generation in utility stations, and the balanced power and process steam requirements of industrial plants. Their modern appearance is indicative of their sound design and superior performance. Both the steam and electrical elements are made by Elliott and the result is a coordinated unit, specifically designed to the individual needs of the plant or station.

New Engineering Bulletin...

"Fundamentals of Turbine Speed Control" contains 32 pages of the latest information on this important aspect of turbine design and performance. Write for Bulletin H-21 to the Elliott Company, Steam Turbine Department, Jeannette, Pa.

ELLIOTT Company



TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

HERE'S PROOF:

9 OUT OF 11 UTILITIES PREFER BAILEY INSTRUMENTATION

In October, 1955, eleven electric utilities added a total of 966,619 KW of steam generating capacity. The installations ranged from 6,000 KW up to 270,000 KW.

9 of the 11 installed Bailey meters
7 of the 11 have Bailey combustion control
9 of the 11 are using Bailey feed water control
6 out of 10 use Bailey steam temperature control

In 31 out of a possible 43 applications in these power plants, Bailey equipment was chosen. And in 6 of the 11 stations, Bailey was the exclusive choice in all applications.

This unanimity of preference for Bailey . . . from Michigan to Georgia, from Maine to California . . . suggests just one conclusion:

Regardless of plant size, regardless of plant location, Bailey is the first choice of America's utilities.

Make Bailey your choice.

For breadth of product line, depth of experience, size of field service organization, no one offers more to the power industry than Bailey. And the time to contact Bailey is during the early planning stage when our recommendations can save time, trouble and money.

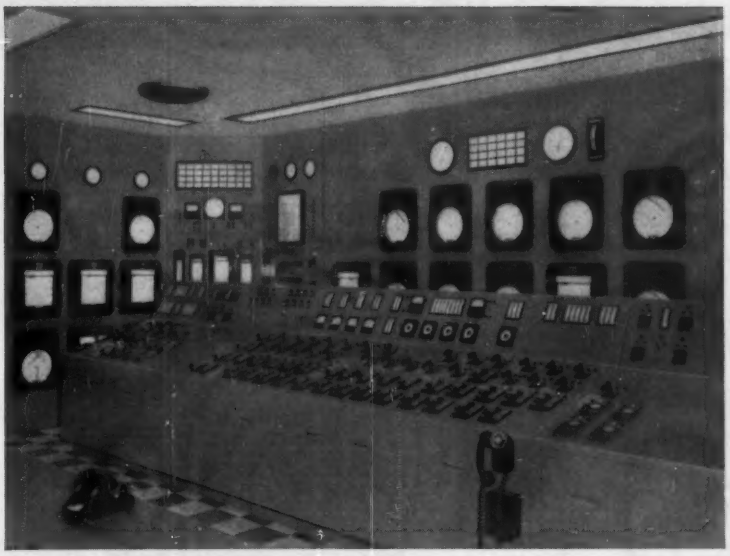
NEW STEAM-ELECTRIC GENERATION PLACED IN OPERATION DURING OCTOBER 1955

SOURCE—REPORTS TO FEDERAL POWER COMMISSION AS PUBLISHED IN ELECTRICAL WORLD DEC. 12, 1955

STATE	UTILITY	PLANT	CAPACITY (KW)	METERS ON BOILER	COMB. CONT.	F.W. CONT.	S.T. CONT.
Maine	Central Maine Power Co.	Mason	30,000	X	X	X	X
N. Y.	New York State Electric & Gas Corp.	Milliken	108,000	X	O	X	O
Ohio	Ohio Edison Co.	R. E. Burger	270,000	X	O	X	X
Ind.	Crawfordsville Electric Light & Power Plant	Crawfordsville*	11,500	O	O	O	O
Ind.	Indiana-Kentucky Electric Corp.	Clifty Creek	180,000	X	X	X	X
Mich.	Upper Peninsula Generating Co.	Presque Isle	22,000	X	X	X	O
Kans.	Central Kansas Power Co.	Colby	6,000	X	X	X	
Ga.	Georgia Power Co.	Hammond	100,000	X	X	X	X
Tex.	West Texas Utilities Co.	Paint Creek†	30,000	O	O	O	O
Calif.	California Electric Power Co.	Highgrove	40,000	X	X	X	X
Calif.	Pacific Gas & Electric Co.	Morro Bay	169,118	X	X	X	X

Code: X—BAILEY, O—OTHERS. *Bailey Fluid Meter †Bailey Oxygen and Combustibles Recorder

A129-2



In the control room of Hammond station, Georgia Power Company, they use Bailey meters and Bailey controls for combustion, feed water, and steam temperature. Out of October, 1955's steam plant additions, some Bailey equipment was chosen for each of the 11 plants.

Instruments and controls for power and process

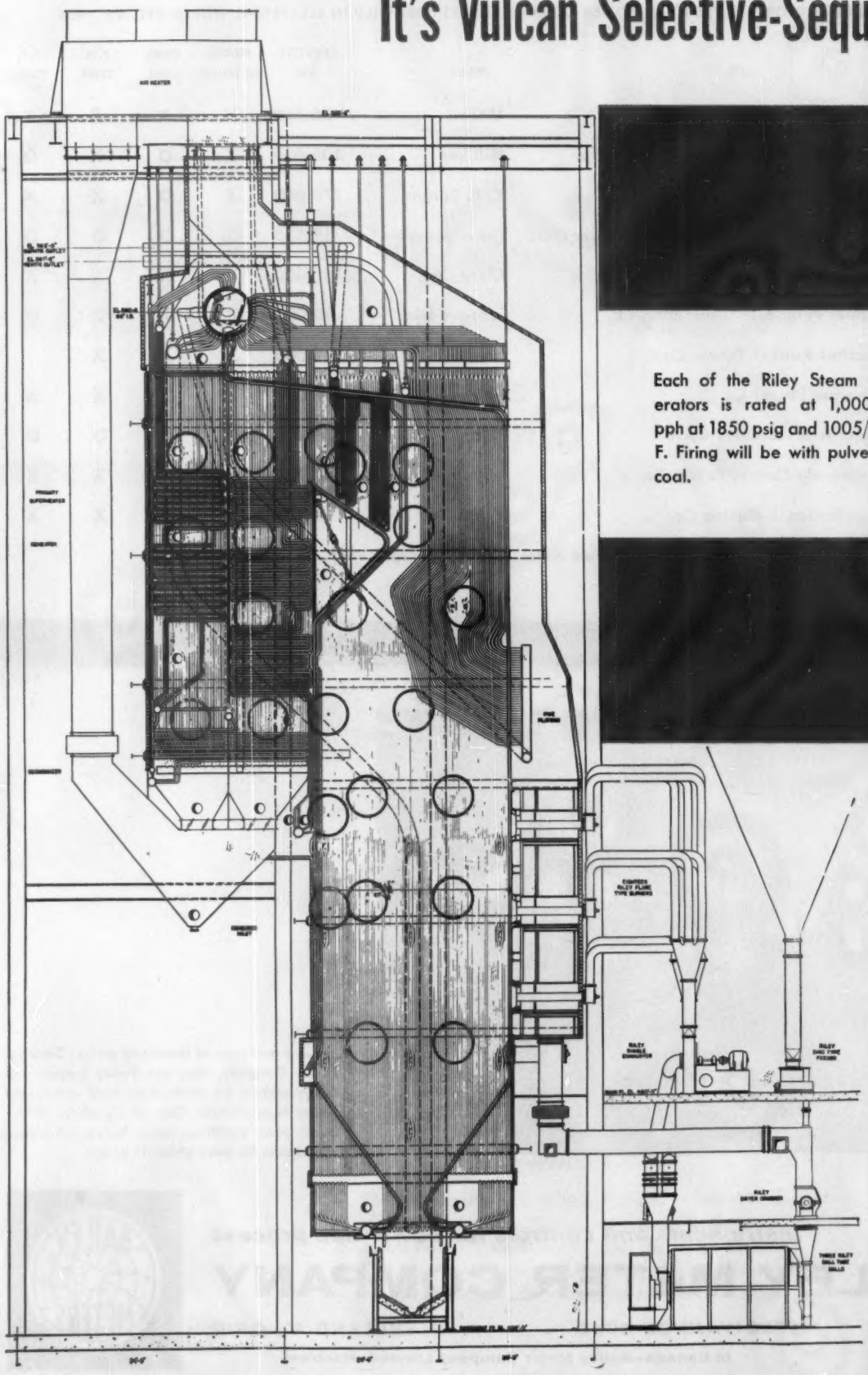
BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

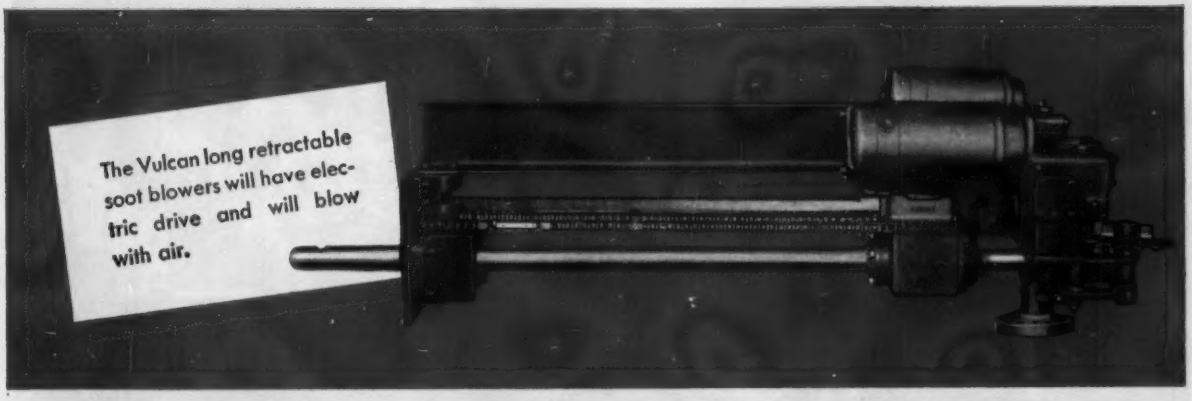
BAILEY METERS

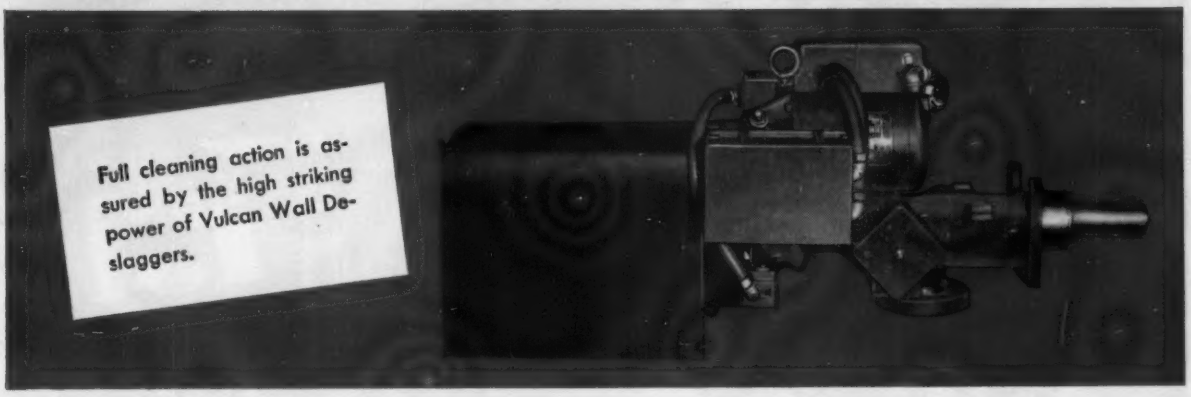
It's Vulcan Selective-Sequence



Each of the Riley Steam Generators is rated at 1,000,000 pph at 1850 psig and 1005/1005 F. Firing will be with pulverized coal.

at New Albany Generating Station





Boiler cleaning systems for Units 1 and 2 in the New Albany Station of Public Service Company of Indiana will be under Vulcan Selective-Sequence Control. Each of the two Riley Steam Generators will be equipped with a Vulcan Soot Blowing System which includes Long Retracts and Wall Deslaggers.

Selective-Sequence operation of the soot blowing system was chosen to give positive operation at proper intervals in precisely the sequence necessary for the most effective cleaning. Vulcan Long Retractable Soot Blowers with two motor operation assure maximum coverage with uniform cleaning of all surfaces. Vulcan Wall Deslaggers deliver maximum striking power to drive off slag, assuring high heat-transfer capacity and uniform control of superheat and reheat temperatures.

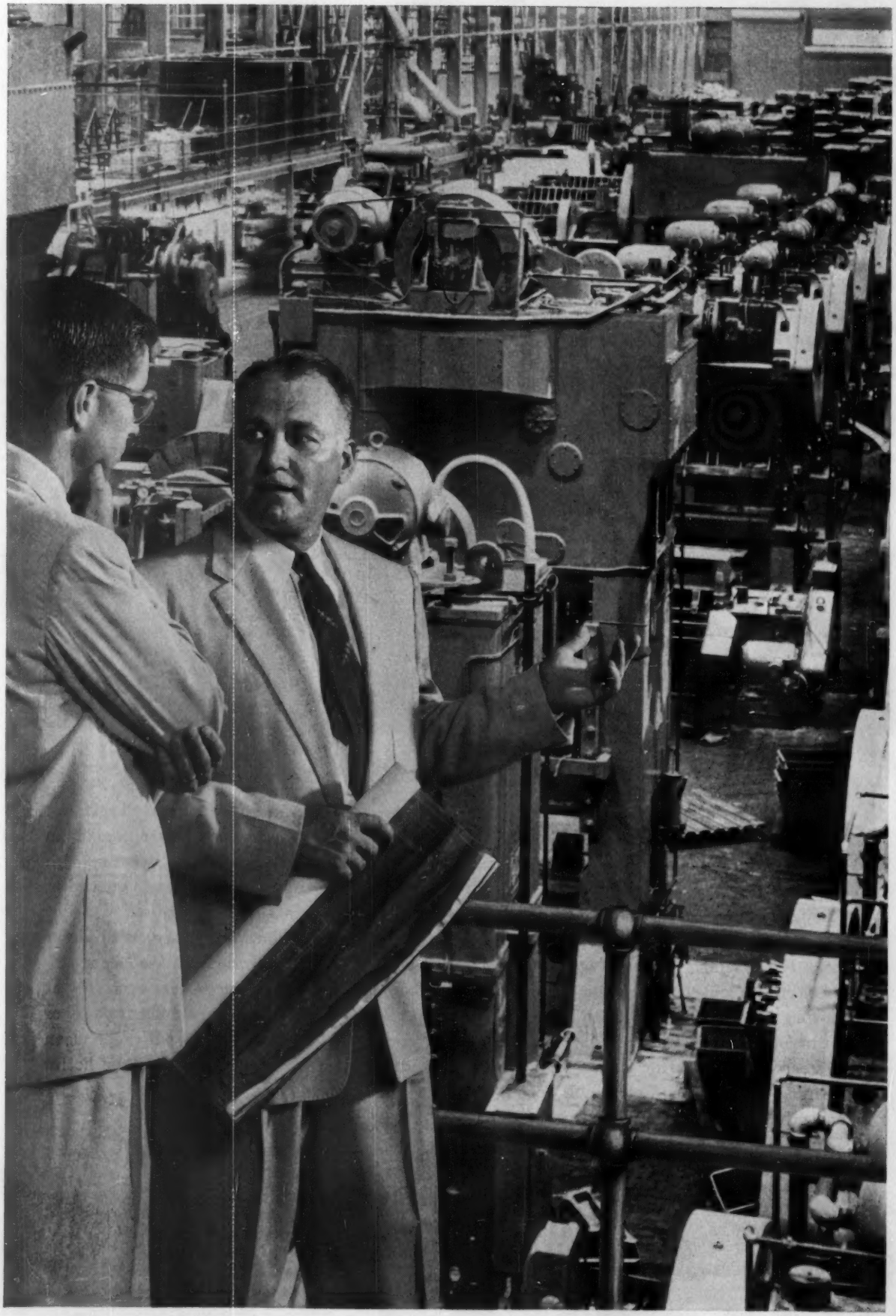
Modern soot blowing systems, with either automatic-sequential or selective-sequence control, can help keep your boilers operating at peak efficiency. Whether your boiler is power or process, large or small, investigate Vulcan Automatic Soot Blowing Systems for better cleaning results.

COPES-VULCAN DIVISION

BLAW-KNOX COMPANY

ERIE 4, PENNSYLVANIA

50th Anniversary BLAW-KNOX 1906-1956



"What would you say if your boss asked . . .

'Are we ready for automation?'"

"Two years ago I didn't know the answer when the boss asked me, 'Are we ready for automation . . . electrically?'

"As plant electrical services engineer I had to come up with the answer . . . and it was a real surprise. Much of our electric equipment was antiquated and took up a lot of valuable production space. The power supply wasn't as safe, dependable or flexible as we wanted it . . . maintenance costs were soaring.

"We had spent so much time improving manufacturing processes and methods that we had neglected electrical needs. Result . . . we weren't even up to date, let alone prepared for automation.

"Steps were taken immediately to make sure our plant was adequate electrically. Today it has more automatic equipment and work-handling devices, and is equipped for more advanced types of automation. Electrical adequacy is being designed into our new branch plant, too.

"There's no reason why you can't do the same to make your plant more efficient."

J-96100-1X

Industry has electrical adequacy problems . . .

Surveys show that many of the nation's plants are inadequate electrically. A recent study of 42 plants in a given area revealed 88% had electrical problems that interfered with production.

These Problems Can't Wait

	Percent of Plants Inadequate — Electrically*
Inadequate transformer capacity and flexibility	42%
Questionable breaker interrupting capacity	63%
Lack of power centers	62%
Poor power factor	25%
No motor control centers	42%
No plug-in bus duct	32%
Low primary distribution voltage (below 4160 volts)	49%
Low secondary voltage (below 480 volts)	25%
Lack of network distribution systems	90%
Lack of automatic switching to maintain continuity	69%
Absence of 277-volt lighting	94%

*Based on report of survey in 156 top U.S. plants conducted by *Factory* magazine.

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***

"I called in Westinghouse...

We got dependable, flexible power supply for greater productivity"

Westinghouse switchgear is available in 10 basic units with a selection of standard instrument panels . . . future additions or replacements can be made easily and quickly any time.

Westinghouse dry-type transformers save space, mount conveniently in out-of-the-way places. Well suited for wet, dirty or hot locations. Placement close to work load saves long, costly secondary runs.

Expansion with Westinghouse control centers frequently saves as much as 40% on installation costs over decentralized methods of mounting motor control. Inspection and service are simplified.

"When I found what some of our troubles were, I called in some expert help from Westinghouse. Working with our staff and our consulting engineers, Westinghouse further studied the condition of our plant power distribution system . . . its construction, age and state of repair.

Switchgear improved safety, operating continuity

"We installed Westinghouse low-voltage, metal-enclosed switchgear which had high interrupting capacity for safety and operating continuity. This reduced our maintenance, brought economic advantages and freedom to expand our facilities.

"Unitized switchgear reduced special design and engineering expense for our new installation, and also provided custom-built preciseness in meeting our application requirements.

Capacitors paid for themselves in 18 months

"Capacitors were carefully applied with Westinghouse help at the substation bus, on secondary bus duct, and right at the motor loads. In the first year, savings on our power bill amounted to 75% of capacitor installed cost. Capacitors paid for themselves in 18 months, and savings are still being realized.

"The capacitors reduced the burden on our feeders and released electrical capacity for other needs. We got better voltage regulation at our motor and lighting loads.

Transformers gave us power . . . where we wanted it

"Placing Westinghouse transformers strategically throughout our plant gave us power close to the load . . . conveniently, economically. Oil- and askarel-filled units were used where we needed high-impulse levels, while dry types were used when light weight, and ease of installation were key factors.

System flexibility with packaged control

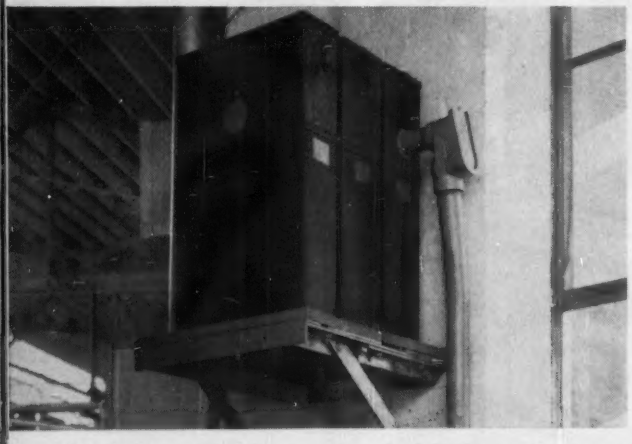
"Some of our machines were subject to frequent moving, so we used Westinghouse plug-in bus duct with individual controls at each machine. For our permanent arrangements, we used control centers for simplicity in planning and installation, a high degree of safety and flexibility, centralized operation and maintenance. In both cases, we found that Westinghouse packaged control equipment simplified system design, cut our costs up to 40%.

"Why not call Westinghouse . . . like I did?"

"I'm sure you'll find Westinghouse a real lifesaver in helping out with your plant power distribution systems, too. Their engineering team will gladly work with your staff and your consulting engineers. I got our plant on the road to electrical adequacy by getting in touch with my local Westinghouse representative."

For more information call your local Westinghouse sales office or send coupon. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-96100-2X



Westinghouse capacitors are low in initial cost, require no maintenance, save additional investment in transformer capacity. Solder-sealed porcelain bushings protect against leaks or contamination of dielectric.

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING **TODAY!***

Westinghouse Electric Corporation
3 Gateway Center, P. O. Box 868
Pittsburgh 30, Penna.

☐ I would like a showing of the 20-minute film, *Selecting the Right Industrial Distribution System.*

I'm interested in more information about:

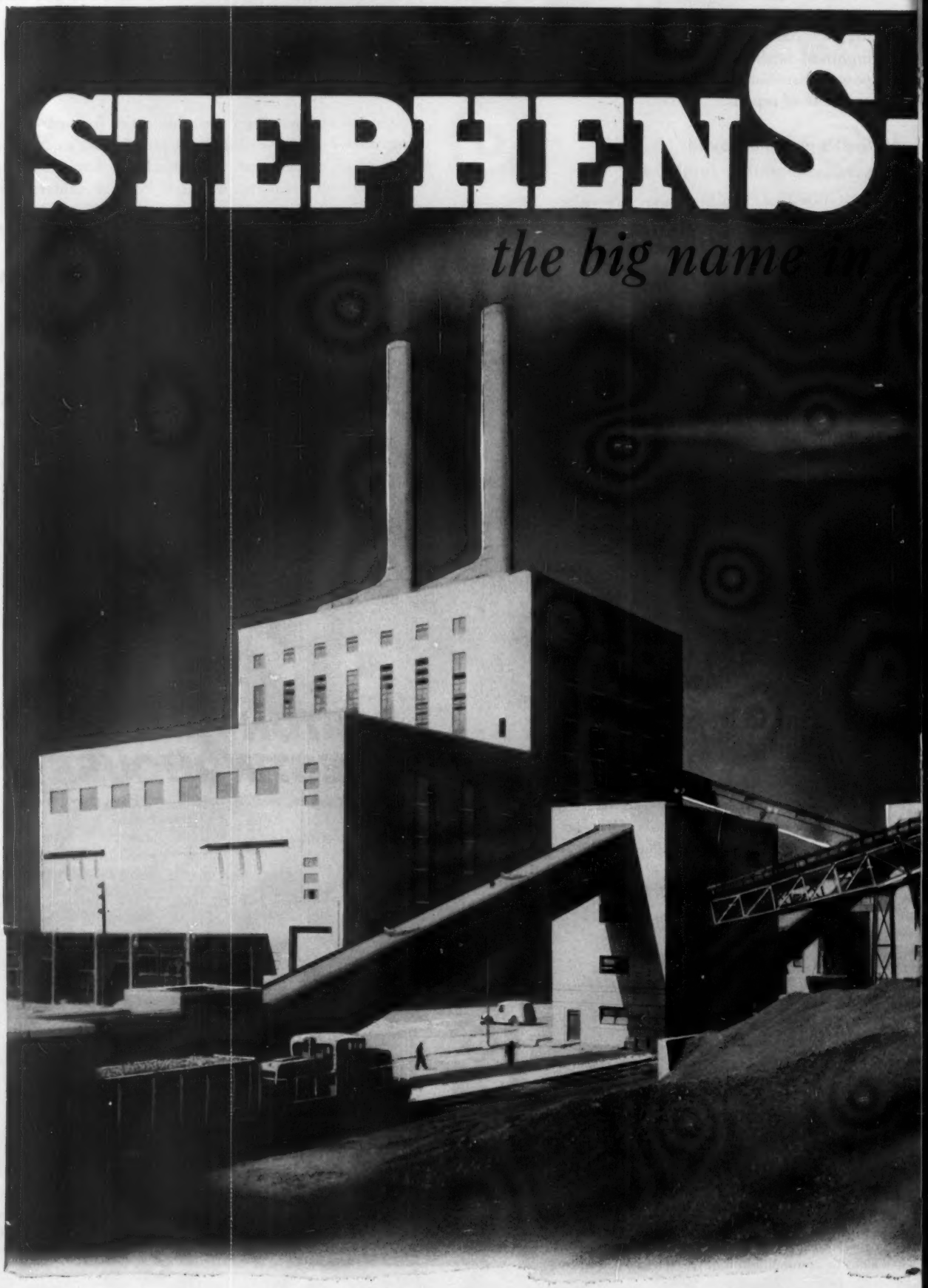
☐ Switchgear ☐ Capacitors
☐ Transformers ☐ Controls

NAME_____ TITLE_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____


STEPHENS-
the big name in

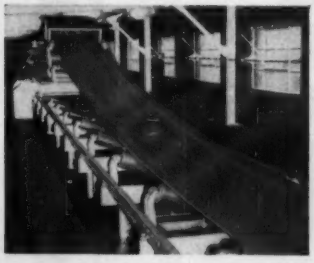
-ADAMSON

coal conveying systems for power

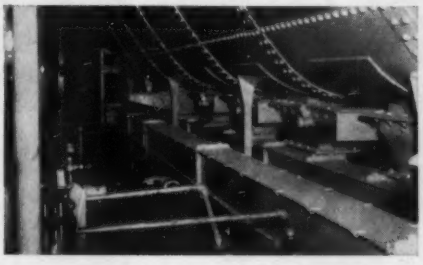
To squeeze every last kilowatt from every ton of coal consumed, power producers know the conveying system must be right. It means a system properly engineered to the specific need with low initial installation cost. It means one that requires minimum maintenance and operational manpower for years to come.

S-A engineer strategists have been planning and building such conveying systems for over fifty years. At this very moment, many of them are helping to provide cheap power in hundreds of private and utility power plants all over the world.

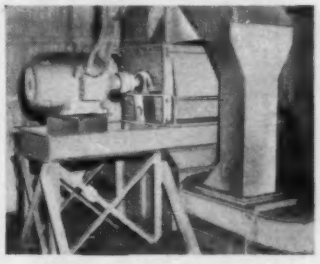
Stephens-Adamson sales engineers, backed by the most complete line of manufactured equipment, blanket all important industrial areas. They can show you why it pays to convey with S-A.



An S-A belt conveyor brings coal into a mid-west power plant. A belt tripper deposits the fuel into bunkers through traveling tripper spouts.



S-A Redler conveyors provide dust-tight coal movement from storage bunkers. Redler designs permit easy coal movement over horizontal, vertical, or inclined planes.



An institutional power plant employs S-A Knittel crusher to reduce coal lump size. It will handle damp coal without plugging or decrease in capacity.

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

Belt Conveyors	Conveyor Belt Cleaners
Belt, Pan & Plate Feeders	Headshaft Holdbacks
Ship Loading Boom Conveyors	Grizzlies & Screens
Stacking Conveyors	Centrifugal Pilers
Storage & Reclaiming Systems	Bin Gates & Tunnel Gates
"Natural Frequency" Vibrating Conveyors	Car Pullers & Spotters
REDLER Conveyor-Elevators	Bucket Elevators
ZIPPER Conveyor-Elevators	Skip Hoists
	SEALMASTER Ball Bearing Units

• *Write for a bulletin on any of the above products.*

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS

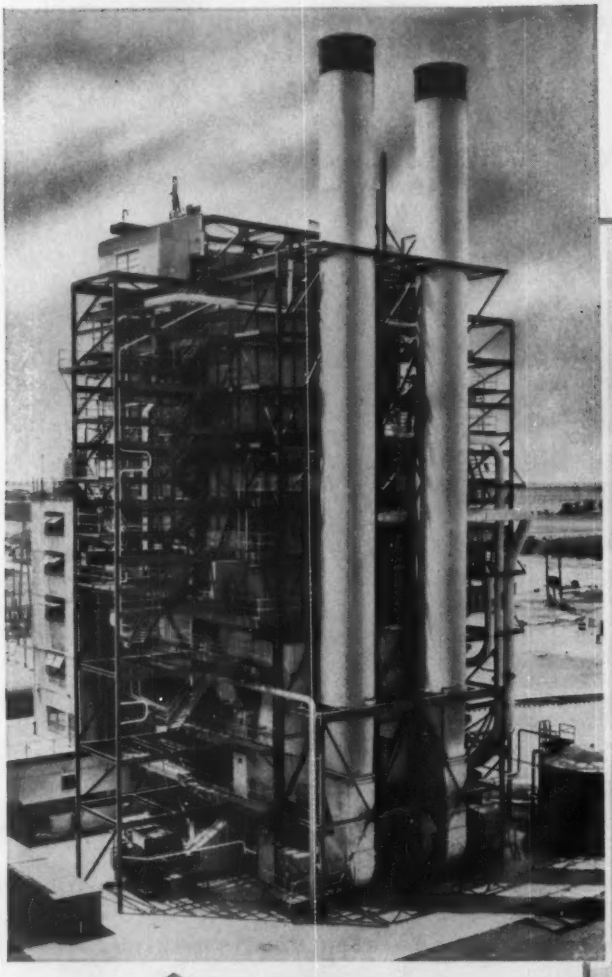
LOS ANGELES, CALIFORNIA

BELLEVILLE, ONTARIO

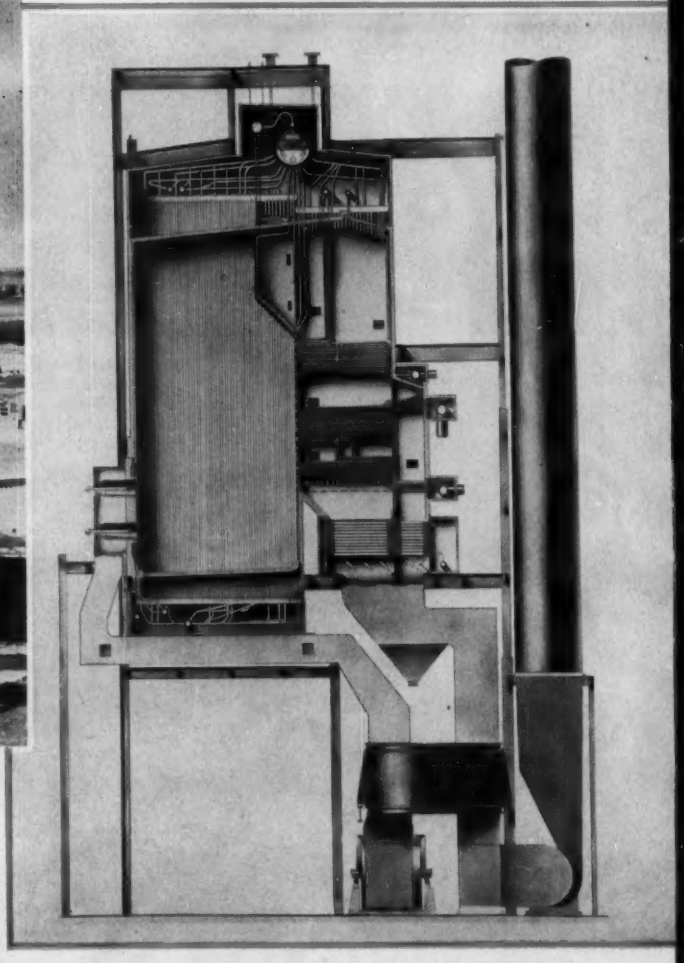
Kansas Gas and Electric puts third*

FW steam generator "on the line" to help . . .

MEET GROWING DEMAND



Foster Wheeler steam generator, unit no. 3, at the Murray Gill Station of the Kansas Gas and Electric Co. just southwest of Wichita, Kansas. A Foster Wheeler 65,000 sq ft surface condenser of the double-flow type serves the 115,000 kw turbine.



Cross-section of the reheat unit shows arrangement of furnace with space provided for possible future conversion to coal firing.

* A fourth FW steam generator, of 800,000 lb per hr capacity is now on order for the Murray Gill Station.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

ON MURRAY GILL STATION

Of outdoor design, this 800,000 lb per hr Foster Wheeler reheat steam generator supplements two other FW units of 425,000 and 625,000 lb per hr capacity serving this modern central station.

CUSTOMERS of Kansas Gas and Electric Company are consuming more and more electric power. The greater use of electric appliances in the home, increased commercial business, enlarged industrial production – all are resulting in an ever-growing demand on the company's facilities.

And at the Murray Gill Station, the company's newest and most efficient operation, with a total generating capability of 240,000 kw, three Foster Wheeler steam generators are now helping meet this upward trend.

The third FW unit to be installed at Murray Gill went into service in April of 1956 – 20 months after placing of contract. It has a capacity of 800,000 lb steam per hr with corresponding reheater flow of 692,000 lb per hr and steam outlet conditions of 1005 F/1005 F and 1925 psig at the superheater outlet.

Repeat orders like this represent a positive expression of confidence in Foster Wheeler steam plant equipment. With more than fifty years of experience in steam generation – and the finest modern manufacturing facilities in three large plants – Foster Wheeler welcomes the opportunity to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

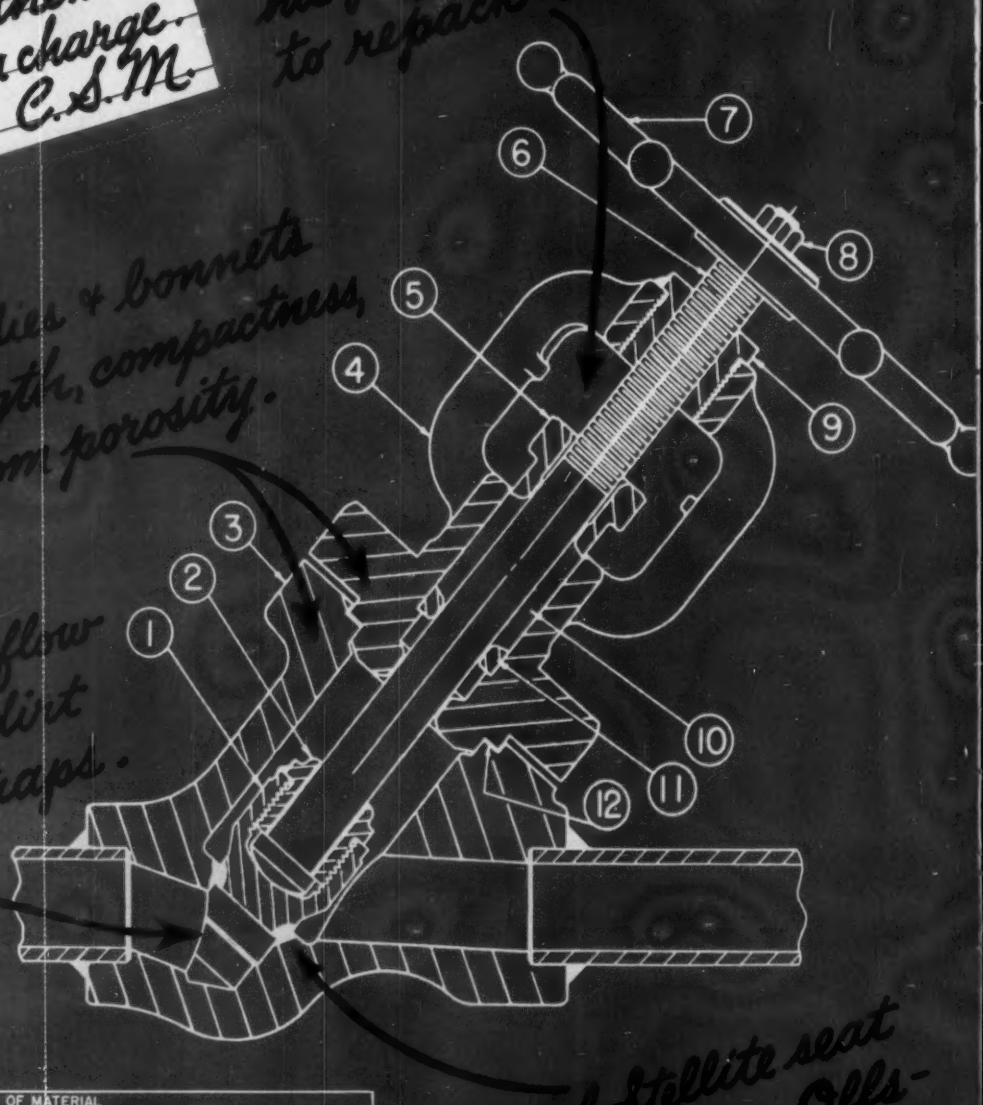
Aerial view of Murray Gill Station of KG&E, showing outdoor-type reheat steam generator at left and FW dual circulation units at right.

R. G. R.–
All boilermakers
Approve Edward
Blow-Off Valves–
will supply them
without extra charge.
C. S. M.

An operator can get his fingers in this yoke to repack valve.

Forged bodies + bonnets give strength, compactness, freedom from porosity.

Streamlined flow eliminates dirt and scale traps.



Integral Stellite seat is best for Blow-Offs– unaffected by temperature changes.

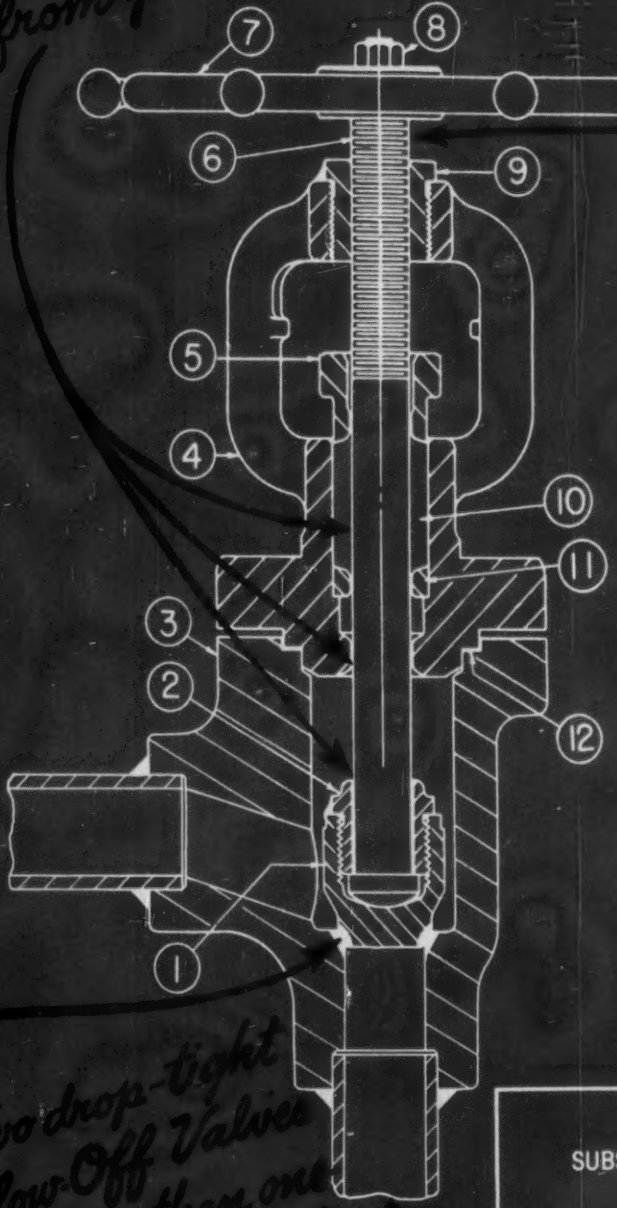
LIST OF MATERIAL
QUANTITIES ARE FOR 1 STRAIGHTWAY OR 1 ANGLE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD MS NO.
1	DISK	1	FORGED ALLOY STEEL WITH	A.S.T.M. A182 GRADE F11 STELLITED SEATING FACE	227 483
2	DISK NUT	1	STEEL	A.I.S.I. G1120	123
3	BODY	1	FORGED STEEL WITH	A.S.T.M. A105 GRADE II STELLITED SEATING FACE	111 483
4	BONNET	1	FORGED STEEL	A.S.T.M. A105 GRADE II	111
5	GLAND	1	MALLEABLE IRON	A.S.T.M. A220, GRADE 53004	324
6	STEM	1	EVALLOY	A.I.S.I. GRADE 416	261
7	HANDWHEEL	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
8	STEM NUT	1	STEEL	A.S.T.M. A194 - CLASS 1	124
9	YOKE BUSHING	1	BRONZE	A.S.T.M. B62	412
10	PACKING RINGS		EVALPAK	HIGH TEMPERATURE PACKING	501
11	JUNK RING	1	STEEL - EVALIZED	A.I.S.I. G1120	123
12	BONNET GASKET	1	IRONKOTE	ARMCO IRON 90 BHN. MAX	505
13	GLAND BOLT WASHER	2	STEEL		
14	GLAND BOLT	2	FORGED STEEL EVALIZED	A.S.T.M. A105 GRADE II	111
15	GLAND BOLT NUT	2	STEEL-EVALIZED	A.S.T.M. A194 - CLASS 0	125
16	TAP END STUD	4	ALLOY STEEL	A.S.T.M. A193 GRADE B7	208
17	BONNET STUD NUT	4	STEEL	A.S.T.M. A194 - CLASS 1	124

ROCKWELL-BUILT
EDWARD STEEL VALVES

Deep packing chamber-dependable backseat assure freedom from packing problems.

Edward Acme form threads are easy to operate at all pressures.



Gadgety designs with internal packing and sliding contacts are potential headaches.

Let's Request Edward Blow-Off Valves

Two drop-tight Blow-Off Valves are better than one - permits repair without shutdown - gives piping flexibility - parts are interchangeable.

EDWARD VALVES, INC.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA

1500 lb. FORGED STEEL BLOW-OFF VALVES

DRAWN Holstein		DRAWING Nº
CHK'D. J Rust		AE-3664-1
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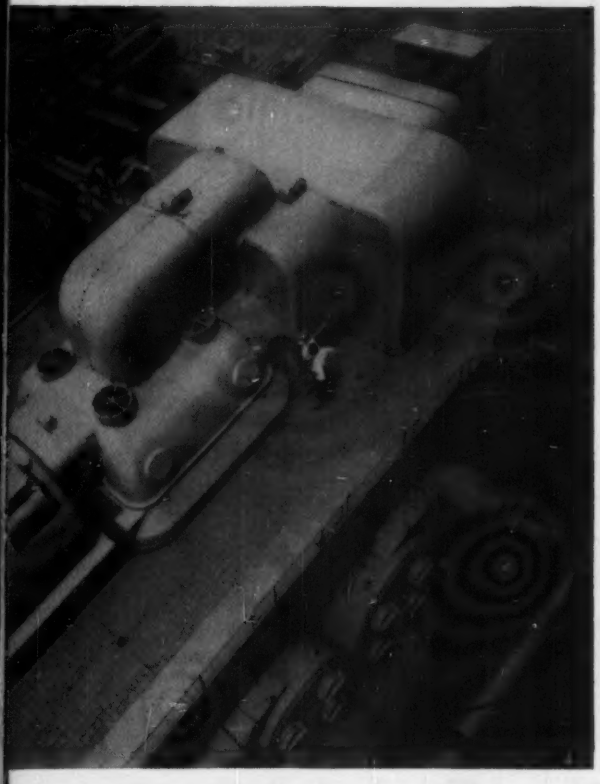
Edward builds Globe and Angle Stop, Non-Return, Stop-Check, Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

The turbine-generating equipment at Ninemile Point station includes three hydrogen-cooled, tandem-compound, double-flow units. No. 1 (in the foreground) is a 66,000 kw unit installed in 1951. No. 2 (next in line) is a 99,000 kw unit installed in 1953. No. 3 (top of page) is a 125,000 kw unit installed in 1955. This plant has an unusually attractive color scheme—the boilers are salmon, the turbines pink, the structural members green and yellow, the piping and stacks silver, and the fire extinguishers red.

Modern, efficient NINEMILE POINT plant uses the modern, efficient turbine oil:

GULFCREST



Close up of recently installed (1955) 125,000 kw turbine generator.

Pictured here are the turbine-generating units at the Ninemile Point station of Louisiana Power & Light Co., New Orleans, Louisiana, reported to be the most fully automatic utility power plant in the U.S.

For safe, sure, long-lasting protection of this key equipment, the lubrication is entrusted to Gulfcrest, the super-refined turbine oil.

After the base stock for Gulfcrest has gone through the usual steps employed in refining other turbine oils, it is processed by an extra refining step—the exclusive Gulf Alchlor Process—which produces a pure and stable lubricant that delivers unmatched performance.

The next time you fill a turbine system, make it a fill for the finest, longest lasting protection by specifying Gulfcrest, the world's finest turbine oil. An experienced Gulf Sales Engineer will recommend the proper grade to meet your specific requirements.

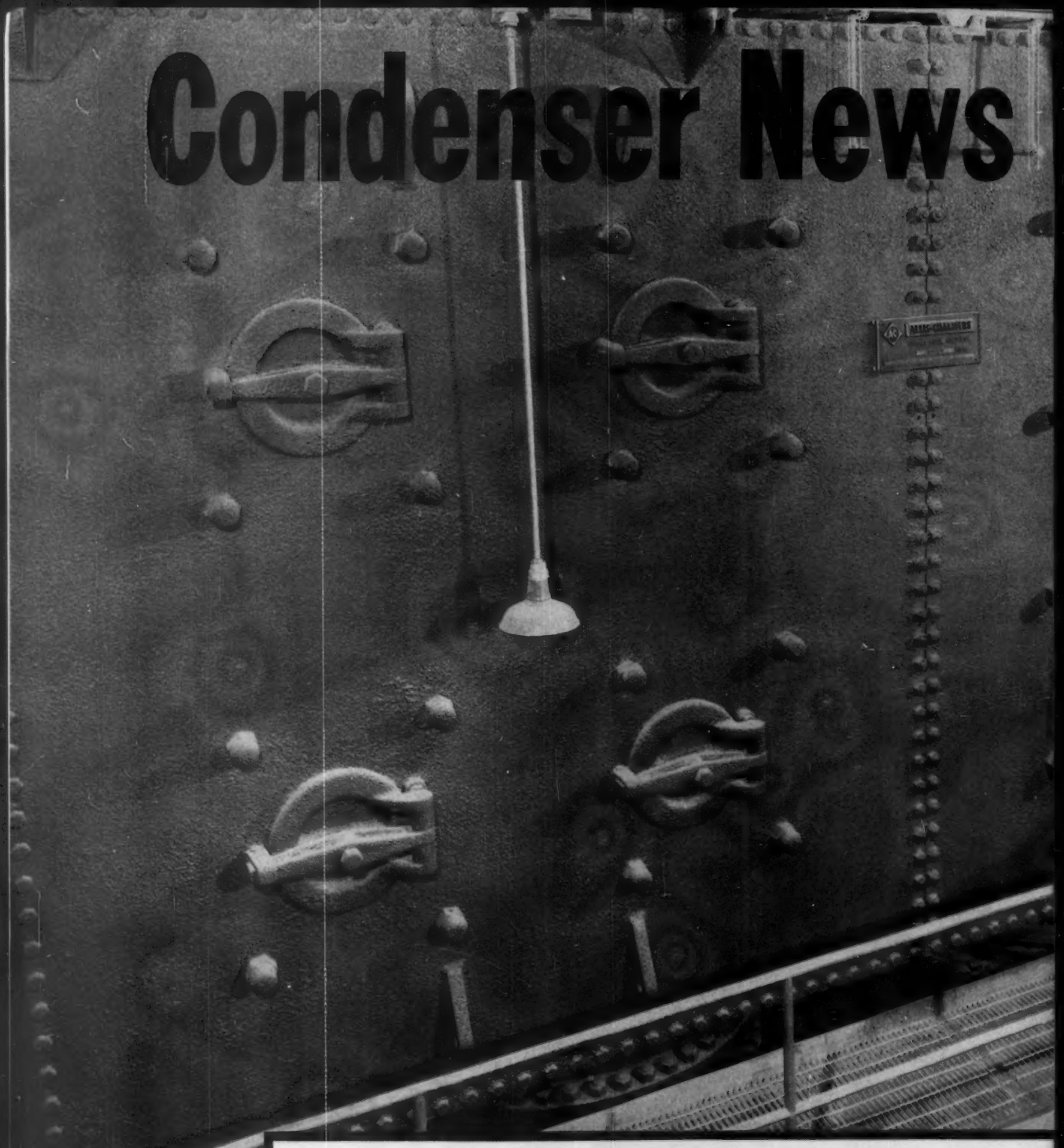
Gulf Oil Corporation • Gulf Refining Company

1822 GULF BUILDING, PITTSBURGH 30, PA.

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

GULF

Condenser News

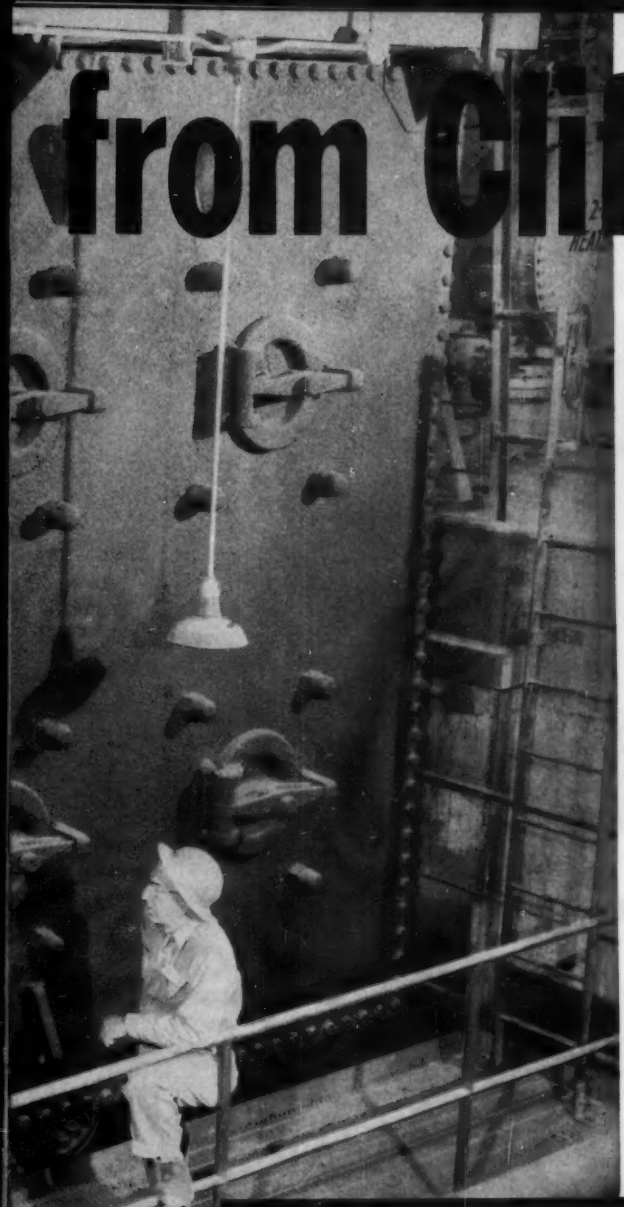


Quick Facts About This Installation

- Each minute, 912,000 gallons of circulating water will be used in the condensers . . . enough for a city of approximately 8,750,000 people.
- Each condenser will handle 979,000 pounds of steam per hour with a heat rejection rate to water of 930 million Btu per hour.
- About 500 miles of tubing went into the six 100,000-sq-ft condensers.

A Size and Type for Any Need

ALLIS-



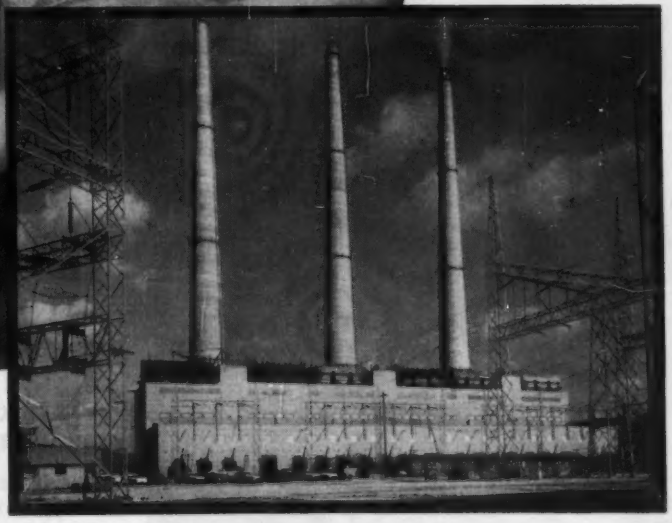
from Clifty Creek

World's Largest Investor Owned Generating Plant Completes Installation of Sixth Allis-Chalmers Condenser

More power for the Atomic Energy Commission! Giant Clifty Creek Plant, with a capacity of 1,290,000 kilowatts — more than that of Hoover Dam — is the largest power plant ever built by private enterprise.

Just completed, Clifty Creek is one of two major steam plants built by the Ohio Valley Electric Corporation to supply the electric power requirements of AEC's tremendous new Portsmouth (Ohio) atomic plant. Clifty is located on the Ohio River at Madison, Indiana. OVEC is sponsored by 15 private utility companies of the Ohio Valley region.

Six 100,000-sq-ft, single-pass Allis-Chalmers surface condensers serve the Clifty Creek Plant's six 215,000-kw steam turbine-generator units.



Condensers of Unusual Design

Multi-steam-path design is a feature of each condenser. This unique A-C design makes *all* tubes completely effective from one end to the other by directing steam to even the most remote sections of the condenser.

The result is high vacuum, high condensate temperature and good deaeration . . . in other words, high operating efficiency.

Get Information

For information about Allis-Chalmers multi-steam-path design, contact your nearest A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-5038

LIVE BETTER ELECTRICALLY

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A-C ALLIS-CHALMERS

Controlling Cyclones Electronically

CONTROL OF OVER 130 BOILER FUNCTIONS

at Ridgeland is centralized on these Republic electronic benchboards.

RIDGELAND STATION
Stickney, Illinois
Units 1 and 2 consist of four superheat coal and gas fired boilers operating at 1800 psi and 1050°F. Units 3 and 4 consist of two coal fired reheat boilers operating at 1900 psi and 1050°F/1000°F.
Sargent and Lundy, Consulting Engineers

at RIDGELAND

Commonwealth Edison's Ridgeland Station near Chicago is the largest completely cyclone-fired power plant in the world. A total of 28 cyclone furnaces fire the plant's six boilers which together can generate enough steam to supply four turbine-generator units with a net capability of 640,000 kilowatts.

To maintain maximum firing efficiency, combustion conditions **at each cyclone** are individually controlled and integrated with over-all plant operation by a Republic Electronic Combustion Control System. The system provides separate controls for primary air, secondary air, fuel feed and fuel-air ratio at each of the 28 cyclone furnaces in addition to controlling forced and induced draft fans and feedwater pumps on each boiler. All told, there are more than 130 individual controls which are automatically coordinated for continuous proper combustion.

Republic Electronic Controls handle all of these functions without introducing transmission lags, complicated pneumatic-mechanical linkages and inaccuracies due to mechanical inertia into the control system. Intergration of control information is greatly simplified by the use of electronic circuits. Expensive panel piping is eliminated and control panels are easier to operate. Because transmission of control impulses is electrical, all parts of the control system can respond simultaneously for smooth, coordinated operation of the boilers.

Ridgeland is but one of many modern cyclone-fired power plants that are equipped with Republic Combustion Controls. In fact, more cyclones are controlled by Republic than by any other make of controls.

Where new developments such as cyclone furnaces call for new control techniques, you'll find Republic engineers and modern Republic equipment up to the task of devising combustion control systems that will meet the requirements of maximum efficiency, dependability and easy operation.

Write us when your problem is combustion controls.

REPUBLIC Automatic
COMBUSTION CONTROLS
(pneumatic or electronic)

- **FOR ALL SIZES AND TYPES OF BOILERS**
- **FOR ALL METHODS OF FUEL FIRING**
- **FOR ALL LOAD CONDITIONS**
- **FOR ALL ARRANGEMENTS OF DRAFT**

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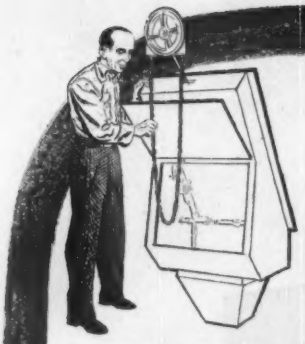
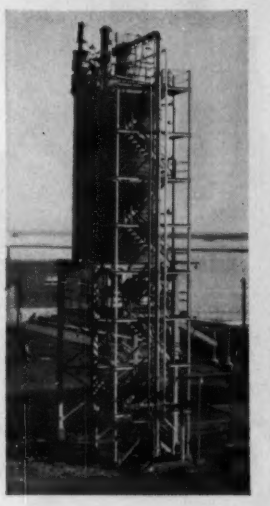
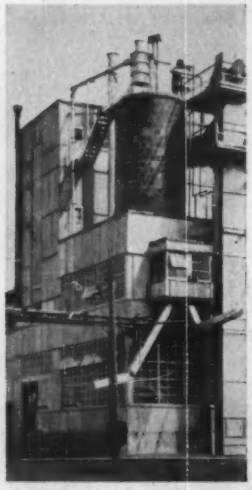


100 ton Ash Silo straddling R.R. track with full stairway to roof. High capacity Ash Conditioner on open platform with discharge to R. cars.





Ash Silo constructed integrally with boiler house. Ash Conditioner mounted inside building. Bifurcated chute allows R.R. car or truck loading.

Ash Silo for truck loading with enclosed room for ash conditioner.

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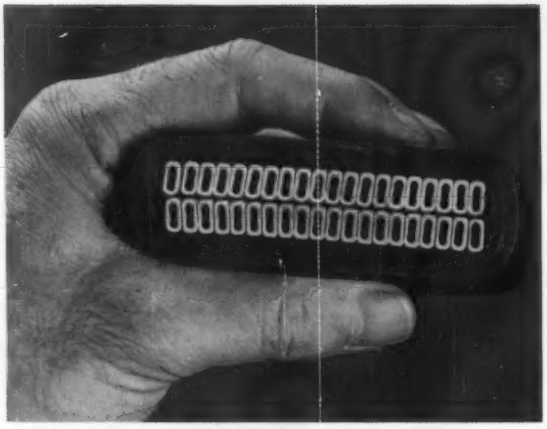
World's first large generator with liquid-cooled armature windings goes to Eastlake

New General Electric cooling system

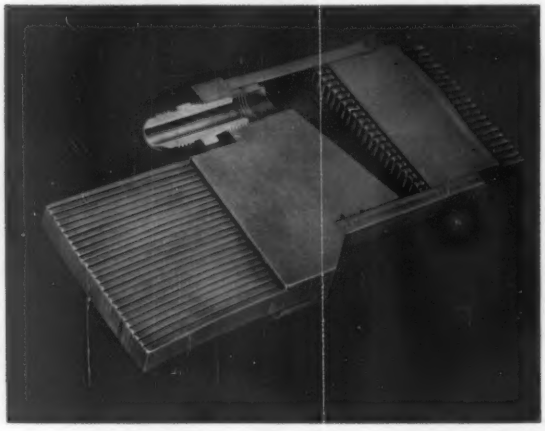
...without appreciable

This evolutionary new 260,000-kva generator incorporates one of the most significant advances in generator cooling since General Electric pioneered hydrogen cooling in 1937. Now in operation at the Cleveland Electric Illuminating Company's Eastlake Plant, it is the world's first large generator with liquid-cooled armature windings. The liquid circulates right through the conductors.

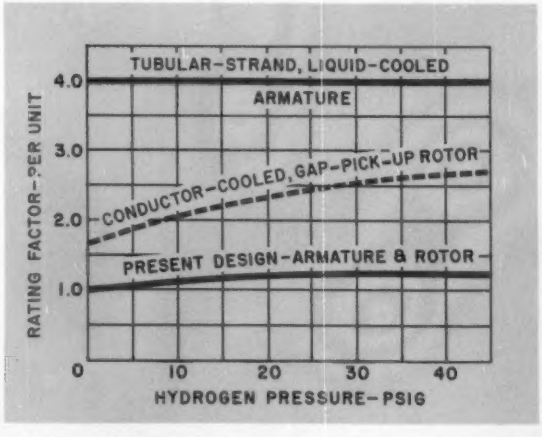
THIS DESIGN IS THE MOST EFFECTIVE method of cooling yet developed. Combined with the new conductor-cooled, gap pick-up type rotor, a typical unit's rating may be doubled without appreciable increase in physical size.



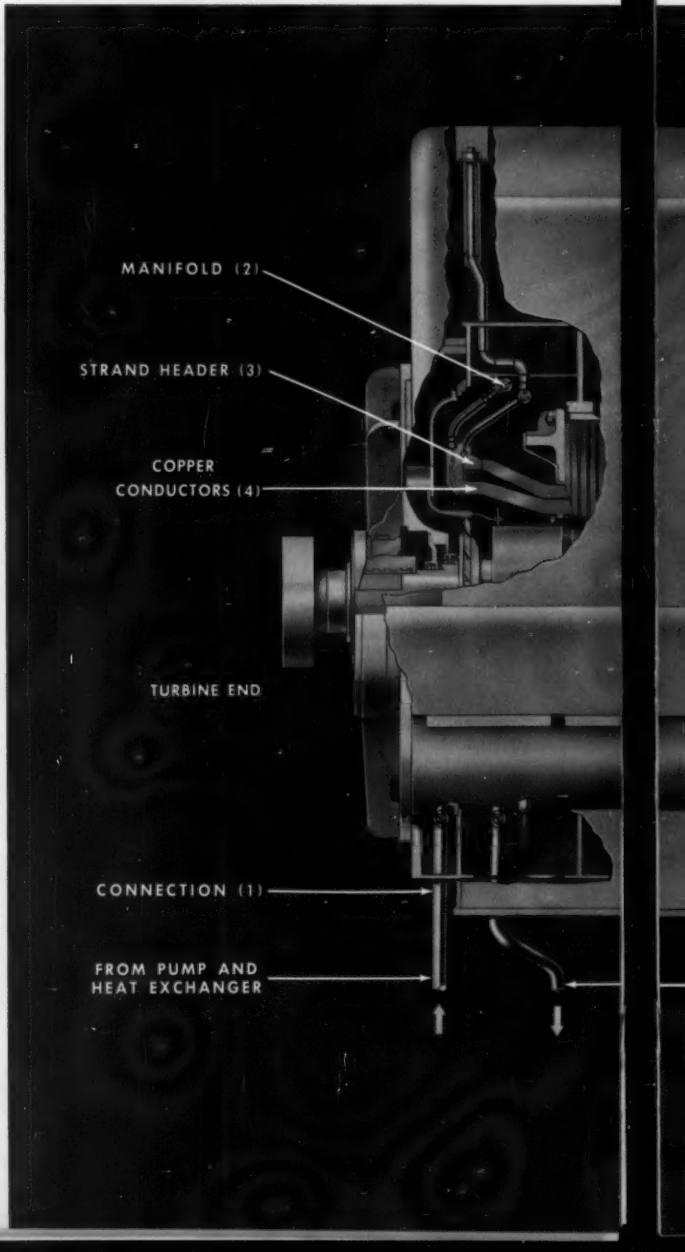
CROSS-SECTION OF ARMATURE BAR shows hollow tubular conductors which carry liquid coolant as well as current. Maximum heat removal is possible because of direct contact between cooling liquid and conductors.



COOLING LIQUID enters tubular conductors through strand header at end of armature bars. Cut-open section above shows how conductors are brazed to header.



HIGHER CAPACITIES are possible with new G-E conductor cooling development. Bringing liquid coolant in direct contact with the armature conductors can remove as much as sixteen times the heat that could be removed from them through the normal ground insulation with the same copper temperature.



can double generator rating

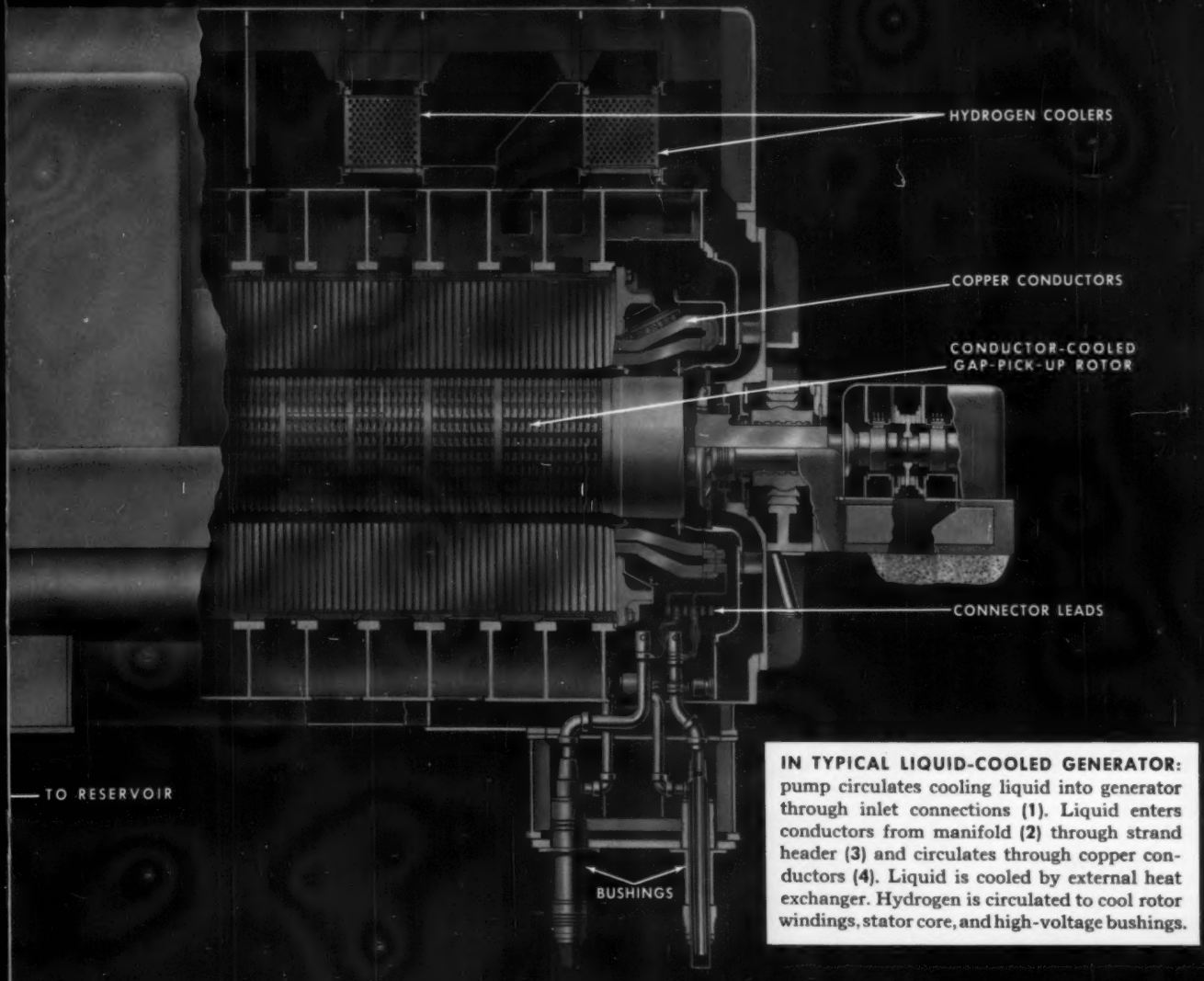
increase in physical size

Even with the increased current output made possible by liquid cooling, efficiency of this General Electric unit remains high. Design features such as: extra transposition of end windings; copper shields on the stator core clamping flanges; and machine dimensions specially designed to reduce windage losses, all contribute to this high efficiency.

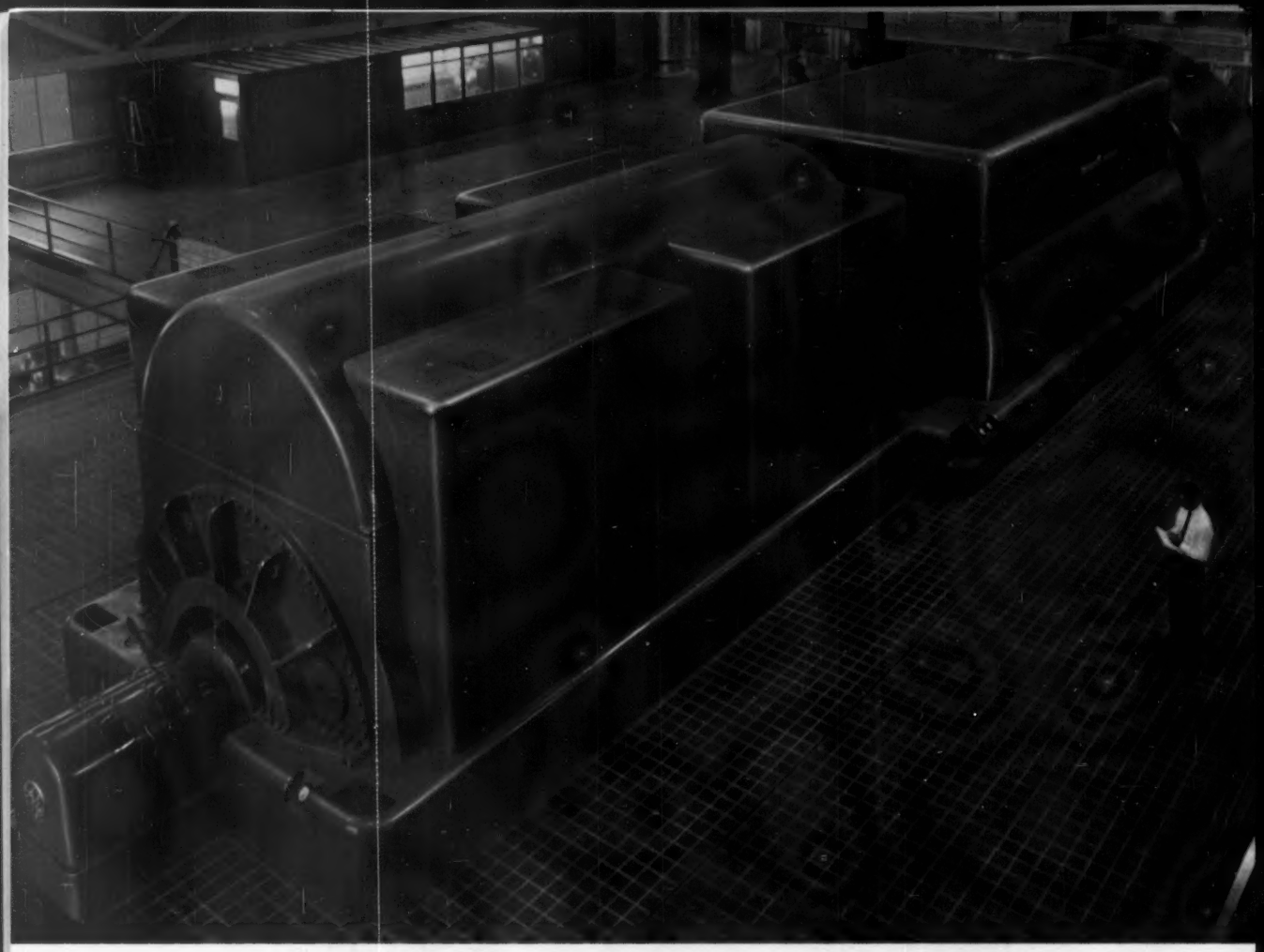
The coolant circulates in a double wall guarded circuit within the armature frame. A special brazed header provides permanent joining of tubular armature conductor strands. Both the liquid and the parts enclosing the coolant are carefully selected for noncorrosive characteristics.

This 260,000-kva, 30 PSIG Eastlake generator is the largest so rated 3600-rpm generator in the world. The new design developed for Eastlake is a significant step toward doubling generator ratings without appreciable increase in frame size and points the way to much larger machines—as high as 500,000-kva. For more information write for GER-1231, "Liquid Cooling of Turbine-Generator Armature Windings," Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC



IN TYPICAL LIQUID-COOLED GENERATOR: pump circulates cooling liquid into generator through inlet connections (1). Liquid enters conductors from manifold (2) through strand header (3) and circulates through copper conductors (4). Liquid is cooled by external heat exchanger. Hydrogen is circulated to cool rotor windings, stator core, and high-voltage bushings.



New generator produces 66% more power in same turbine room space

Eastlake's new General Electric conductor-cooled 260,000-kva generator (above) represents another milestone in turbine-generator progress. The new generator has increased station capacity 56% yet occupies the same turbine room space as each of the three other conventionally cooled, 156,250-kva General Electric units in this modern plant.

Obtaining more kilowatts in the same turbine room space is one of the many challenges created by the increasing expansion of electric utility loads. The Eastlake installation demonstrates how this challenge can be solved by advanced designs.

It is a typical example of how the electric utility industry and equipment manufacturers are cooperating to meet tomorrow's demand for larger blocks of power with turbine-generators of even higher ratings.

This latest expansion of the Eastlake plant is a further step in Cleveland Electric Illuminating Company's program of helping its customers to Live Better ... Electrically. 254-45

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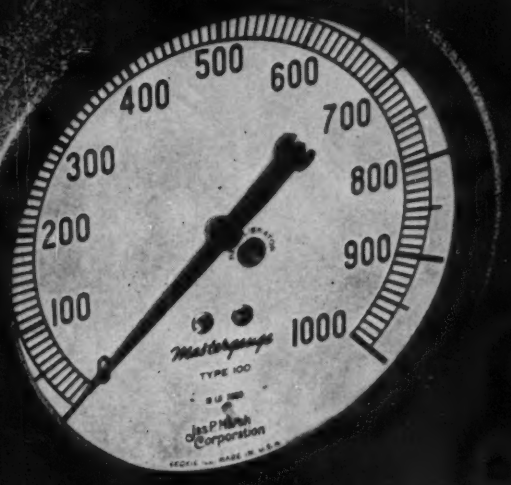

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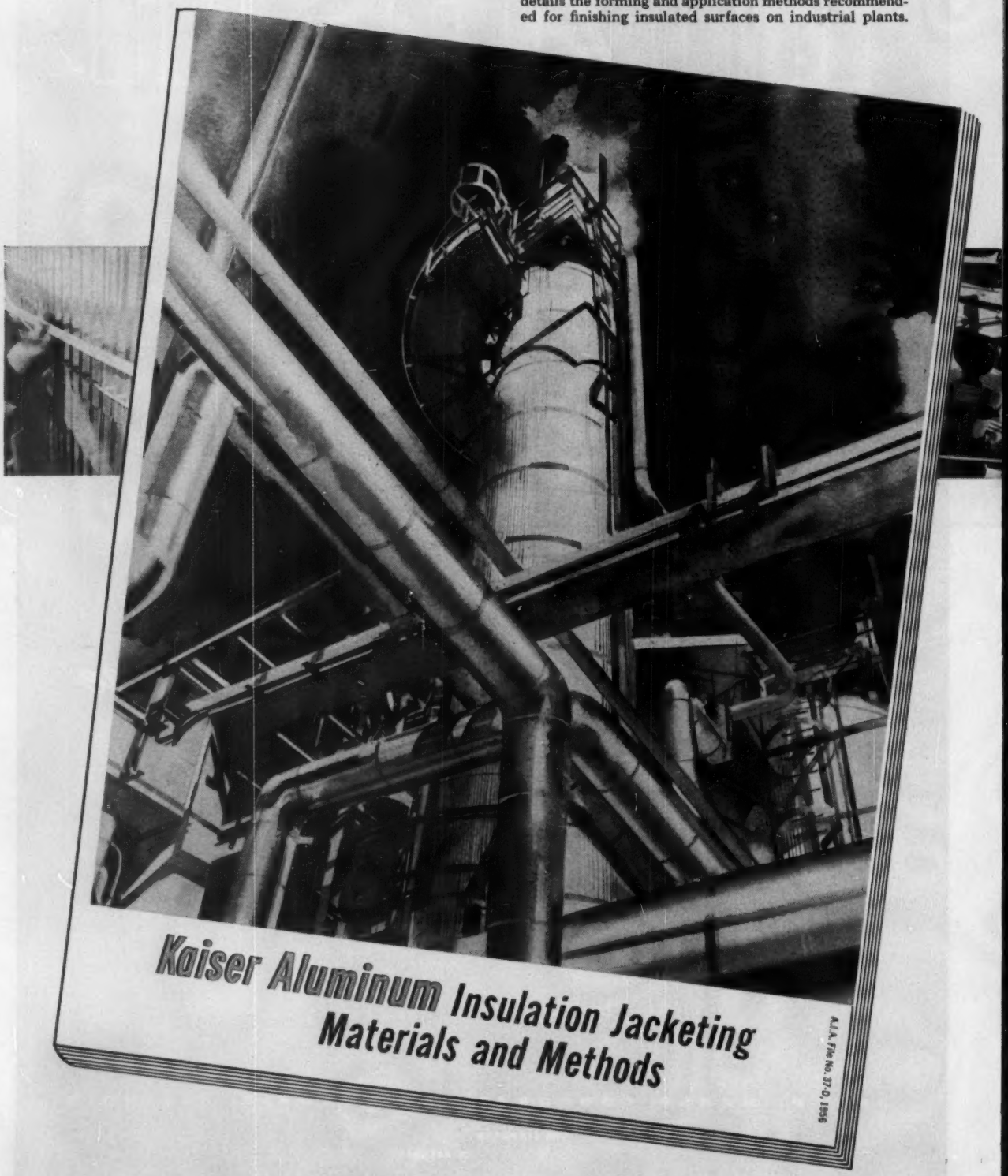

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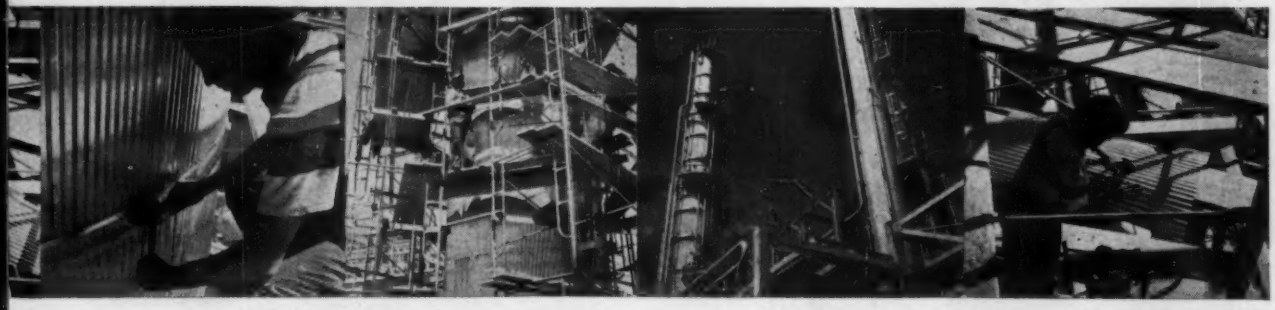

Plant designers, contractors and owners can now take advantage of newly-developed methods for getting more complete coverage of insulation with aluminum jacketing.

This new Kaiser Aluminum manual makes available —for the first time—*complete information on the subject of aluminum jacketing.*

Emphasizes Complete Coverage

Besides showing methods for jacketing tanks, vessels and straight runs of piping, the manual shows how to jacket fittings and heads—elbows, T's, valves, flanges, reducers, branch connections, expansion couplings, tank roofs, outlets and flat, dished and conical heads.

And because these methods include adaptations of the construction industry's efficient "dry wall" techniques, they give you these other important advantages: faster, safer application, lower costs, neater installations that require less cleanup.

On-the-job Techniques Illustrated

Photographs and tables throughout show typical examples of how Kaiser Aluminum is applied in actual industry situations. Drawings and diagrams provide details of expansion joints, pipe jacketing, flashings, insulation and jacketing support arrangements for vertical walls and for storage tank roofs.

Snap Jacket Introduced

The manual introduces *snap jacketing*—refinements of proven techniques developed from Kaiser Aluminum's "idea partnership" with customers. Using these new techniques, one man working alone can quickly apply weather-tight jackets to piping.

Send the coupon today and get your free copy of this valuable manual. And for immediate assistance on any jacketing requirements, call the Kaiser Aluminum sales office listed in your telephone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, California.

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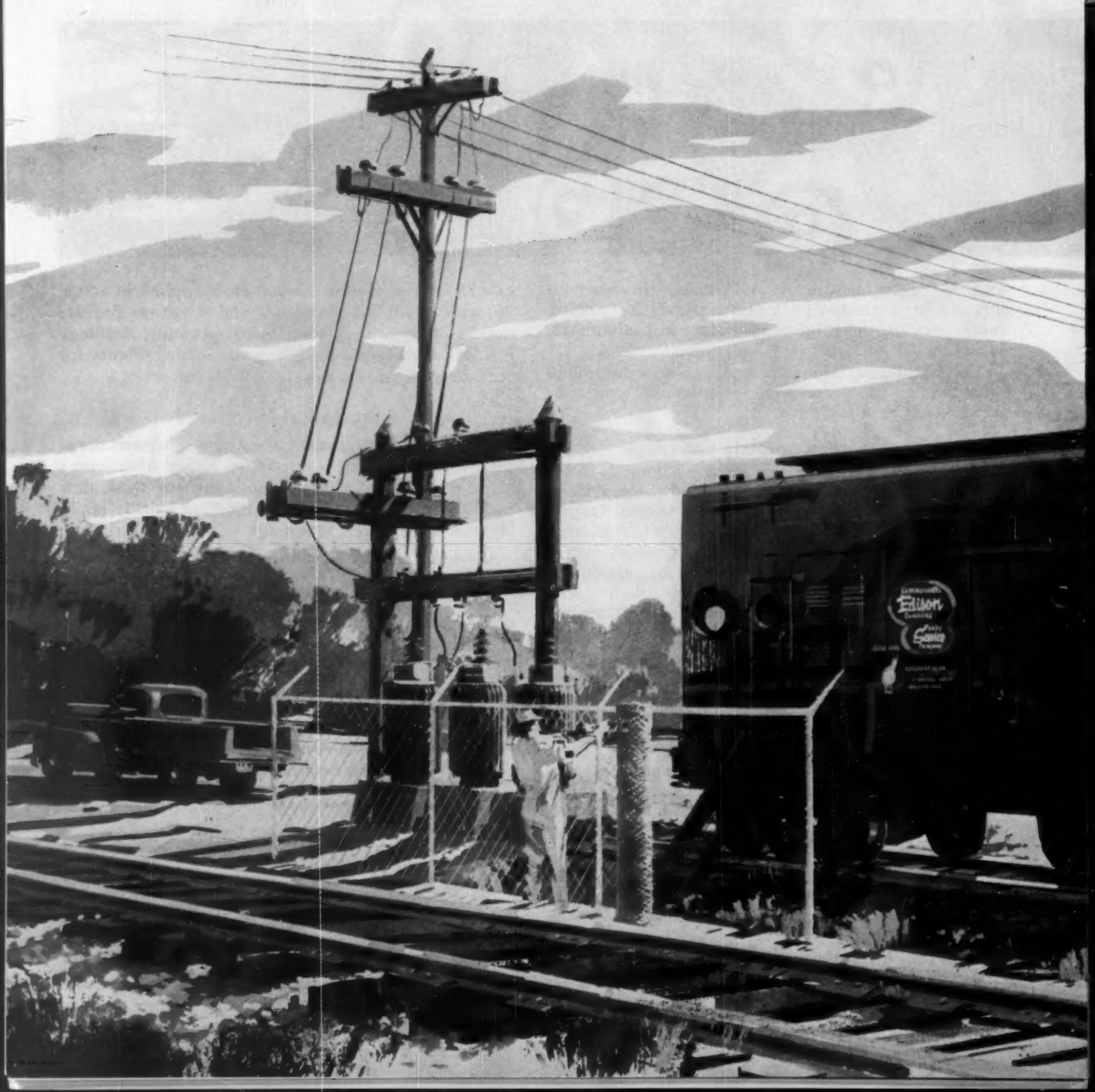

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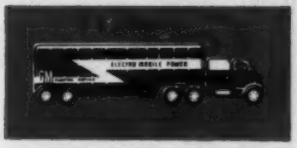

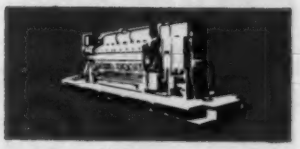

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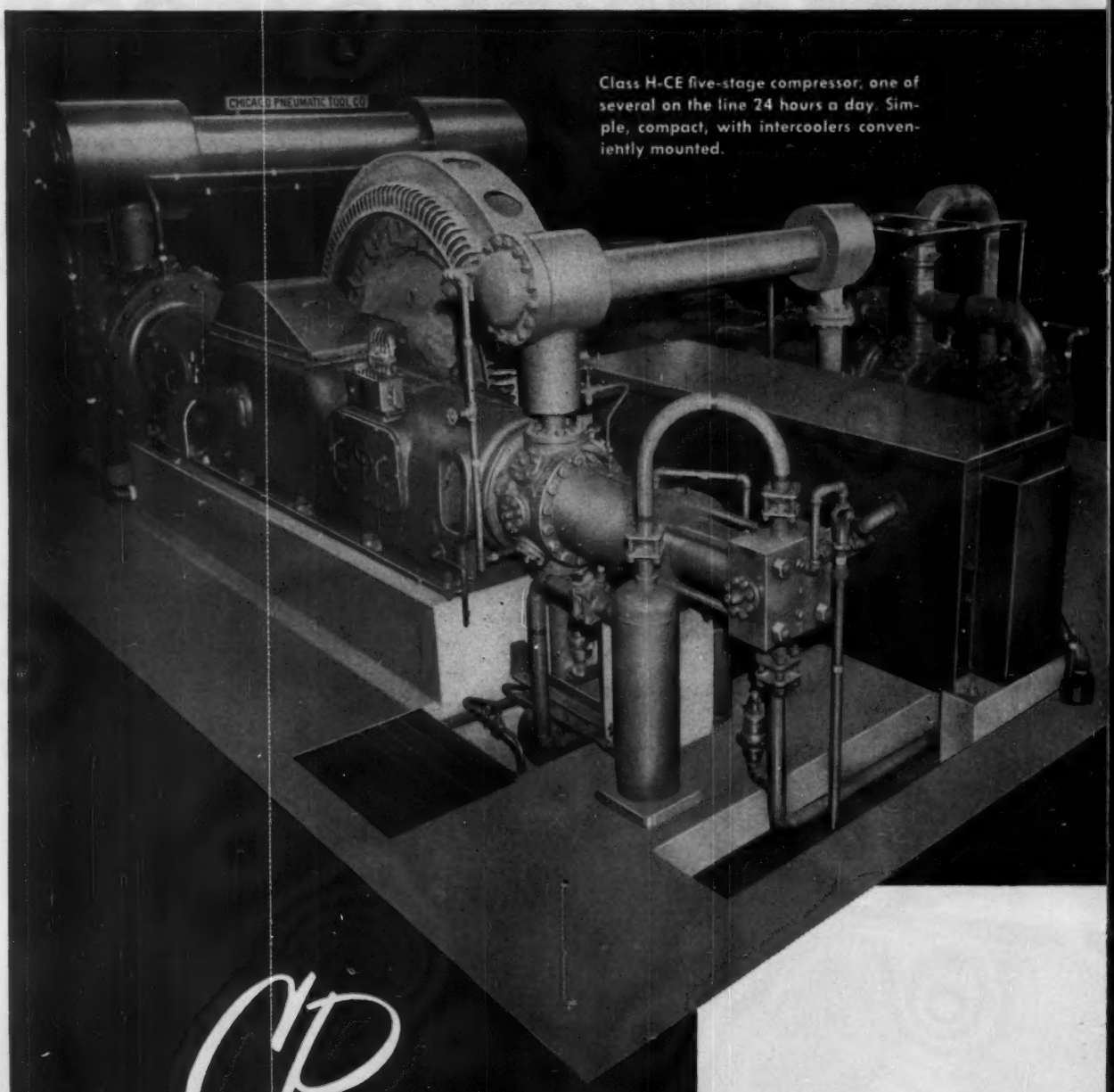

Class H-CE five-stage compressor, one of several on the line 24 hours a day. Simple, compact, with intercoolers conveniently mounted.

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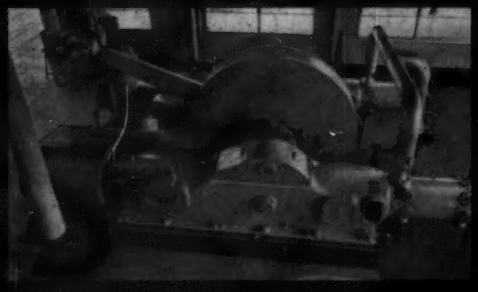
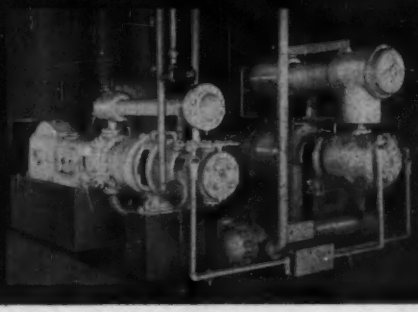
Non-lubricated, hydrogen recycle compressor, with enclosed distance piece; electric motor-driven through gear reducer.



Class "H" steam-driven, single-stage booster compressor handling hydrocarbon gas.



Class O-CE four-stage, motor-driven compressor. Note simple arrangement of intercoolers.

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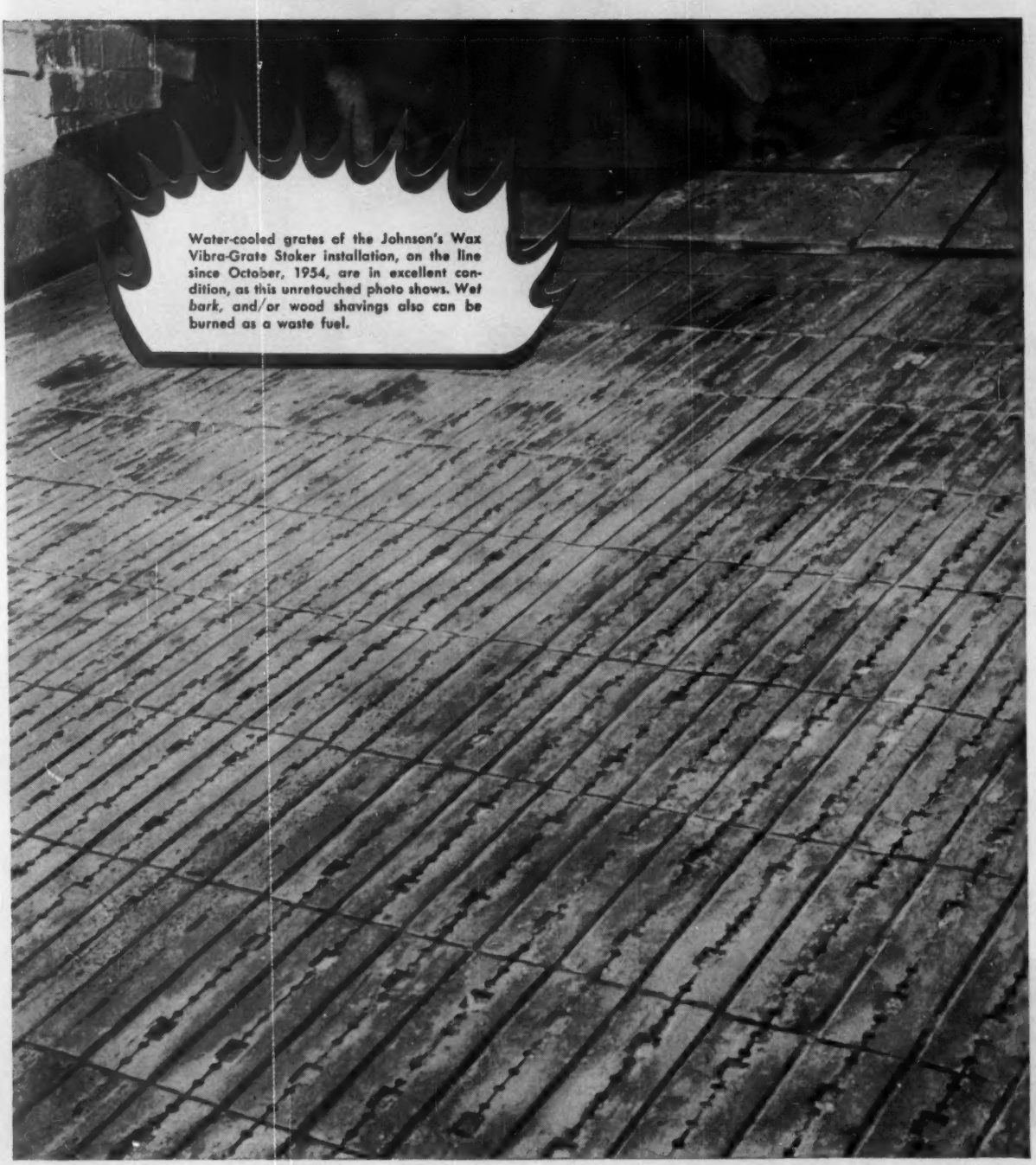
PROVED PERFORMANCE SELLS EIGHT NEW AE



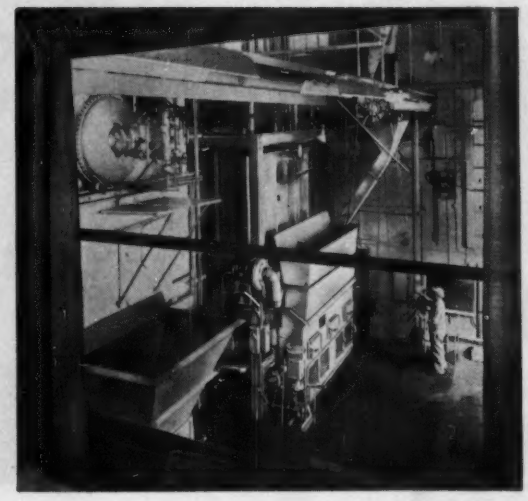
Water-cooled grates of the Johnson's Wax Vibra-Grate Stoker installation, on the line since October, 1954, are in excellent condition, as this unretouched photo shows. Wet *bark*, and/or wood shavings also can be burned as a waste fuel.

OVER 24 MONTHS VIBRA-GRATE STOKERS

Two full years of outstanding service from the Vibra-Grate stoker in the Racine, Wisconsin plant of S. C. Johnson & Son, Inc., manufacturers of Johnson's Wax, have resulted in eight new orders for Vibra-Grates from both public and private users.

A personal examination of the Johnson's Wax installation by technical experts of customer companies convinced them that all claims made for this outstanding stoker were modest compared with its performance records. Grates were in almost new condition, as the unretouched photograph shows – proof that Vibra-Grates can both deliver heat – and take it!

So, if you're thinking of adding a new power plant – or modernizing your present one, write for full details on the Vibra-Grate today.



First commercial installation of its kind in the U. S., the Vibra-Grate Stoker at Johnson's Wax burns low grade coal without smoke, needs no dust-collector, and is water-cooled for long life. Maintenance to date has been zero.

EIGHT AE ADVANTAGES MEAN MAXIMUM OPERATING EFFICIENCY FOR EIGHT NEW INSTALLATIONS

Manufactured by American Engineering Company, makers of the world-famous Taylor Stoker, modern Vibra-Grates provide cost-conscious power plant operators with eight special advantages:

- Unusually effective air seals to insure high CO_2, even at very low ratings
- Freedom from smoke at both high and low steaming rates
- No need for costly dust collectors
- Satisfactory burning of both high and low volatile coals, as well as lignite
- Really effective air zoning from this stoker's modern type of grate; air divisions cannot become leaky and useless
- Minimum maintenance, because of the stoker's water-cooled grate
- High efficiency at all ratings
- Water-cooling protection when burning liquid or gaseous fuels

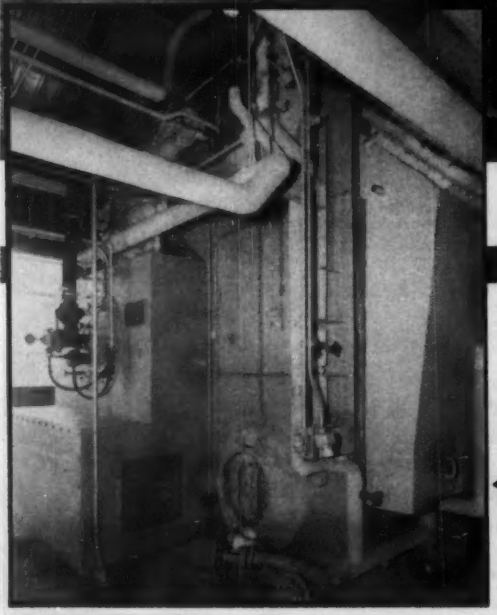
AMERICAN ENGINEERING COMPANY

DEPT. S-100, WHEATSHEAF LANE & SEPVIVA STREET, PHILADELPHIA 37, PA.

Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P.Q. . . . Bawden Industries Ltd., Toronto, Ont.

AF products are: Taylor, Perfect Spread and Vibra-Grate Stokers, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers, Marine Deck Auxiliaries.

"RELIABLE–ECONOMICAL



▲ From an original water color of the Central Soya Co., Inc.—McMillen Feed Mills—by Kent Day Coes. Commissioned by "Factory" magazine for their 1956 Significant Plant Awards.

◀ C-E Package Boiler, Type VP which supplies all steam requirements. Capacity 40,000 lb of steam per hr, operating pressure — 155 psi. Gas fired.

–LOW ON MAINTENANCE"

Says Mr. Max R. Spencer – Superintendent Central Soya Co., Inc. – McMillen Feed Mills

"Our package boiler, after 18 months of operation, has proven to be very reliable, economical and low on maintenance costs. Ease of start-up, shut-down and continuous operation permitted quick training for our operators."

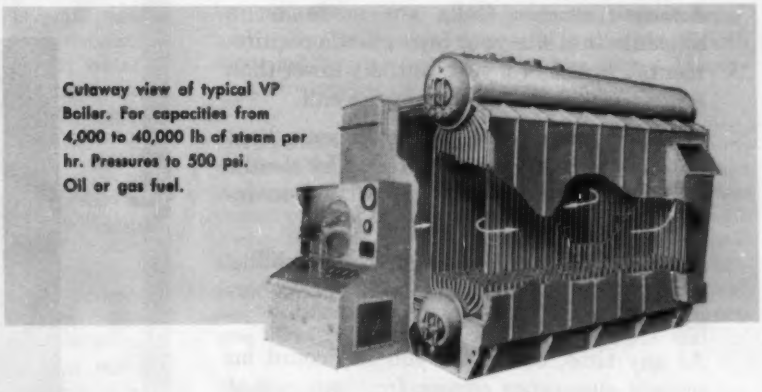
Mr. Max R. Spencer, Maintenance Superintendent of the Central Soya Co., Inc. – McMillen Feed Mills – of Chattanooga, Tenn., was referring to his C-E Package Boiler, Type VP, when he made that statement.

It's a boiler that has to be good – has to be reliable – for it is presently the sole source of steam supply for this outstanding plant. And it *is* an outstanding plant having been named one of "The 1956 Winners of Factory's Significant Plant Awards".

Central Soya is a real, modern "triple threat" operation. It comprises: (1) mammoth new grain-handling elevators, (2) feed mill, and (3) soybean solvent extraction plant all integrated into a smoothly operating "continuous process" plant that is expandable and ready for any foreseeable need.

Combustion Engineering is proud that its VP Package Boiler has been assigned a key role in the operating plan of this notable mill. Gratified, too, that it is proving to be all that Mr. Spencer had hoped for.

A C-E Package Boiler, Type VP can do the same kind of a job for you. Let us give you more information.



Cutaway view of typical VP Boiler. For capacities from 4,000 to 40,000 lb of steam per hr. Pressures to 500 psi. Oil or gas fuel.

COMBUSTION ENGINEERING

B-962

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.
CANADA: COMBUSTION ENGINEERING—SUPERHEATER LTD.

STEAM GENERATING UNITS • NUCLEAR REACTORS • PAPER MILL EQUIPMENT • PULVERIZERS • FLASH DRYING SYSTEMS • PRESSURE VESSELS • HOME HEATING AND COOLING UNITS • DOMESTIC WATER HEATERS • SOIL PIPE

Frequent Instrument Check-ups Prevent Emergencies

The economical way to protect your investment in instrumentation is a Honeywell Periodic Service Plan. Under this plan, a Honeywell service specialist comes to your plant at regular intervals to—

— Check your Brown instruments and calibrate them against accurate laboratory standards.

— Inspect all moving parts, clean and lubricate them, and replace where necessary.

You get this kind of service performed regularly for your office equipment such as typewriters and calculating machines . . . for your automobile . . . and even for yourself by periodic check-ups by your doctor. You've learned that the ounce of prevention is a good investment. Well, the same philosophy applies to instruments, too. Keeping them in good condition is far more economical than waiting for emergencies to throw production schedules into a tailspin.

Here, briefly, is what the Honeywell Periodic Service Plan does. It provides you—

Periodic examination and adjustment by a factory-trained service engineer.

Automatic attention. Calls are made on a schedule that fits your own plant's requirements . . . at a cost substantially lower than an equivalent emergency service call.

Continuous operation. Good instruments kept in top condition can be counted on for steady duty, without costly shut-downs. Well-maintained instruments last longer, too.

Increased plant efficiency. Greater reliability of operation builds confidence of plant personnel in their equipment.

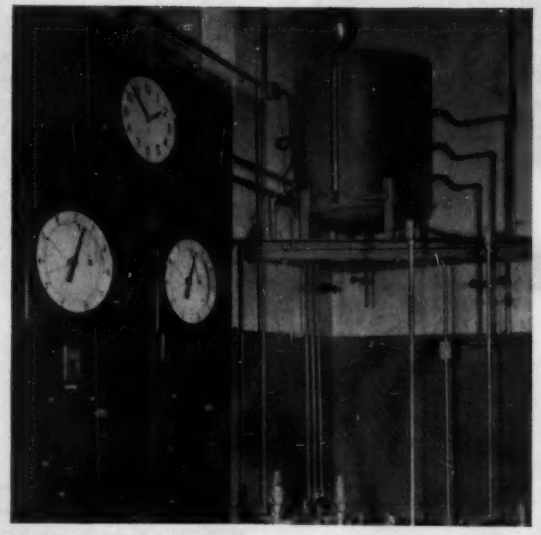
At any time, of course, you can count on prompt emergency service from any one of the more than 100 Honeywell service centers spotted throughout the United States and Canada.

The Plan is extremely simple. It costs remarkably little, and can pay real dividends in protection of your production schedules and your instrument investment. For details about how it can be applied to your own plant, call your local Honeywell office.

Water treating . . .

reduced to routine supervision

by Honeywell



Shown on the water treatment control panel at James Lees and Sons Co., Bridgeport, Pa., are two ***ElectroniK*** *pH indicator-recorders, one with* ***Electr-O-Line*** *control for the caustic feeding system.*

Water treatment plant at the Alan Wood Steel Co., Conshohocken, Pa. In the pump room, Honeywell flow meters, level and pressure gages control the flow of recirculated mill and river water through the treatment process.

instrumentation

At the Alan Wood Steel plant, Honeywell instrumentation was applied to treat waste, as well as to condition incoming river water for mill requirements—a total of 20 million gallons per day. Overall plant efficiency is increased, and maintenance is reduced. By providing a constant supply of uniform water, Honeywell controls effect savings throughout the plant, and permit closer control of process temperatures and pressures. Controlled waste discharge contributes to good community relations.

At the James Lees and Sons plant, water is supplied at the rate of a million gallons per day from the highly turbid Schuylkill River. Until Honeywell instrumentation was installed, variations in volume, turbidity, percentage of suspended solids and concentration of pollutants posed serious troubles. Now, Honeywell controls provide consistently clear water at pH 8. Alum requirements have dropped 90%. Double shifts are no longer needed in the treatment plant. Night and Sunday trouble-shooting by the superintendent is eliminated.

You can save time, trouble and materials—and end water treatment difficulties—with Honeywell automatic controls. Two cases in point: a textile plant with the problem of treating incoming river water, and a steel mill requiring special treatment of both incoming water and waste. In both instances, Honeywell controls provided profitable solutions.

Honeywell instrumentation is now serving in hundreds of industrial and municipal water treatment and waste discharge processes. In every case, it offers closer control and higher efficiency of water treatment. Regardless of your specific need, Honeywell instrumentation can save you money, both directly and in end benefits. Contact your nearby Honeywell sales engineer for help with your water or waste treatment problems . . . he's as near as your phone.

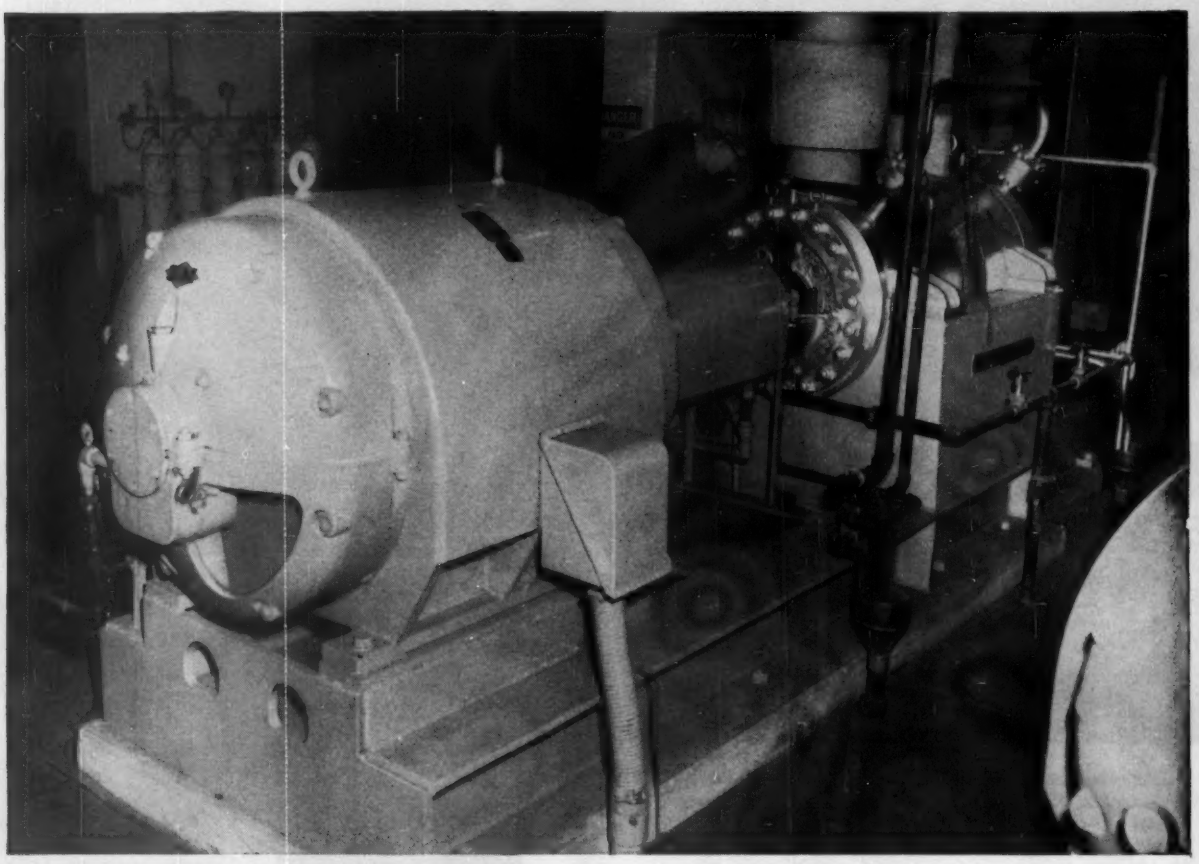
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

H HONEYWELL

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls



"Here is a 1000 hp, 3600 rpm E-M Induction Motor," says Pete Powerhouse, E-M auxiliary drive specialist, "driving a feedwater pump for a large utility. This motor can take it. We use Kolene-processed bearings, the most rugged and dependable type you can specify for tough 2-pole motor service."

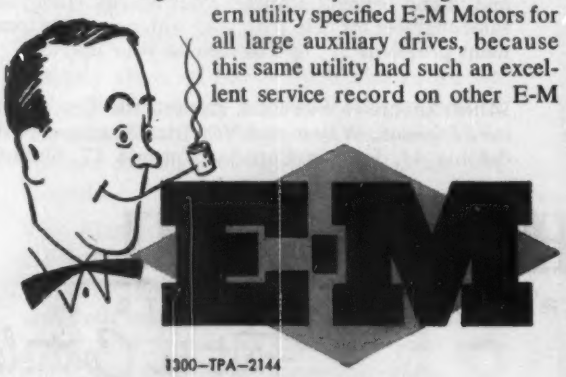
Pete Powerhouse says...

"Dependable Service

SOLD THESE POWER PLANT MOTORS"

● "I'm Pete Powerhouse, E-M auxiliary drive specialist. My business is motors in the powerhouse class, extra rugged for the gruelling demands of utility operations.

"I was glad to see recently that a large midwestern utility specified E-M Motors for all large auxiliary drives, because this same utility had such an excellent service record on other E-M Motors in their various plants.



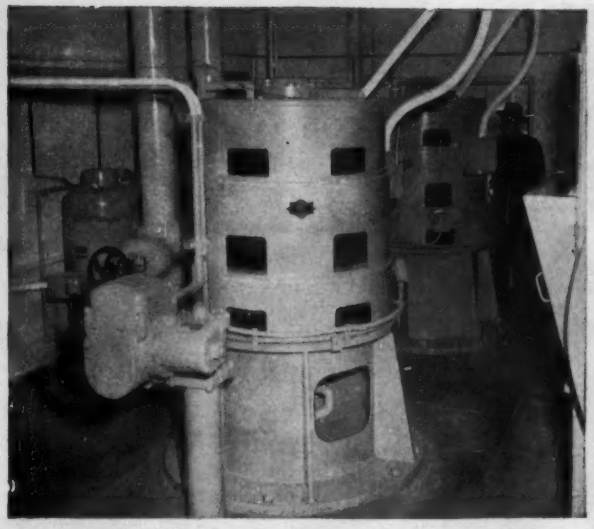
"We consider extra dependability like this a trademark of E-M Motors. We at E-M have over 40 years of experience in intensive design and careful construction of large motors.

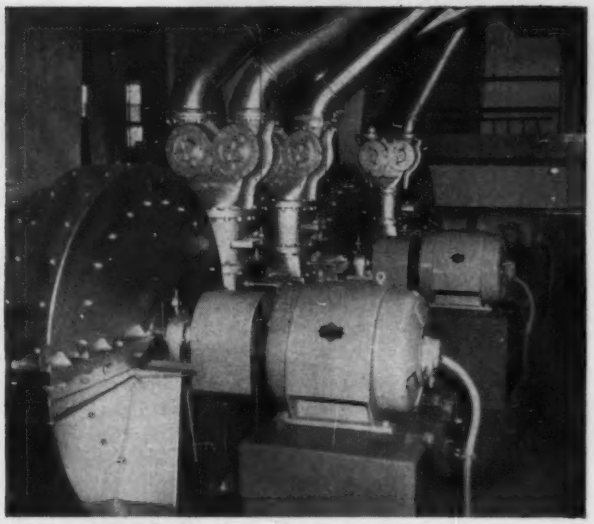
"Are you considering auxiliary drives? Ask your nearest E-M sales engineer for data, or write us at the factory for E-M Publications 189 and 214. They talk about auxiliary drive motors in detail."

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

Specialists in making motors do
EXACTLY WHAT YOU WANT THEM TO

1300—TPA—2144



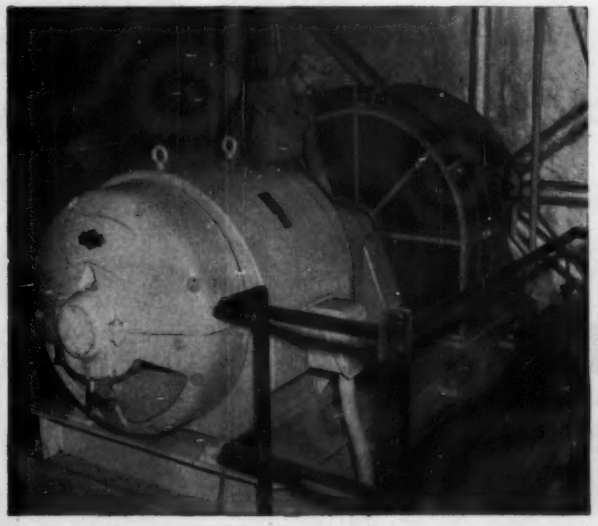


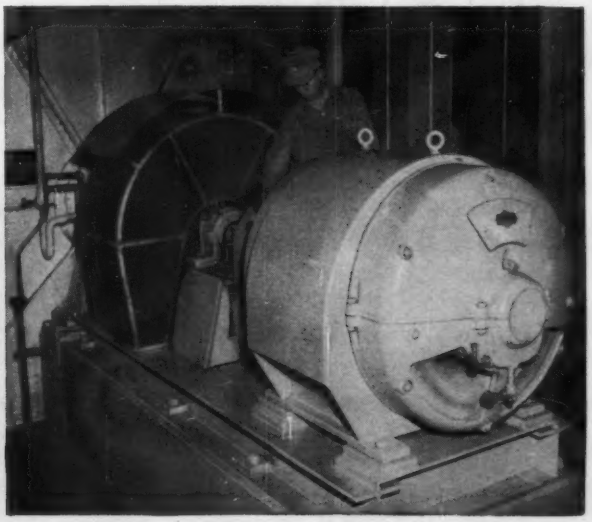
"Pete Powerhouse again. Here are two 150 hp, 495 rpm E-M Induction Motors driving vertical circulating pumps for this utility. Sectionalized frame construction of our Vertical Motors lets you get at core, coils, rotor and bearings in four easy steps. Routine care and maintenance is quick and convenient."

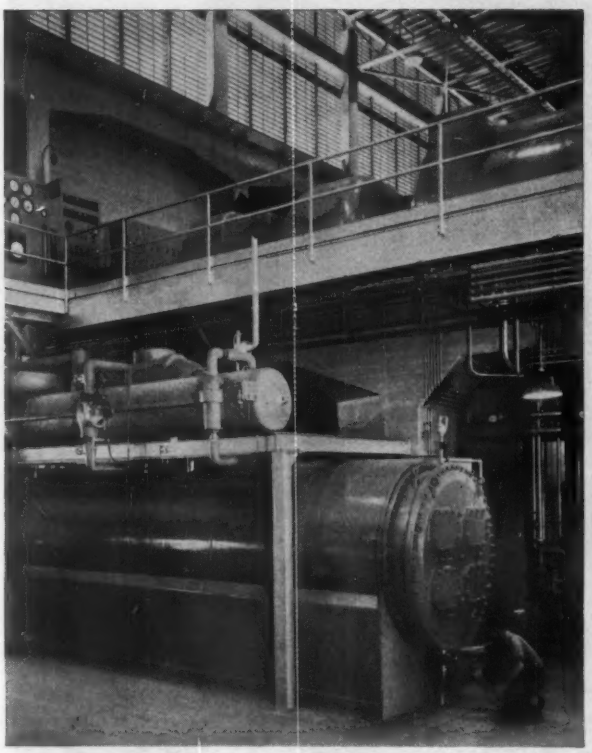
"These three coal pulverizers are driven by three 250 hp, 900 rpm E-M Induction Motors. Extra protection against moisture penetration, high humidity, fumes and harmful dusts is a must on these important drives. We use "Powerhouse" Insulation Treatment to give this vital protection."

"Here's a combination that's hard to beat for driving induced draft fans . . . a 700 hp, 885 rpm E-M Induction Motor and an adjustable-speed E-M Magnetic Drive. Heavy steel E-M Motor frames and enclosures are extra rigid, and pleasing in appearance, with no excessive weight."

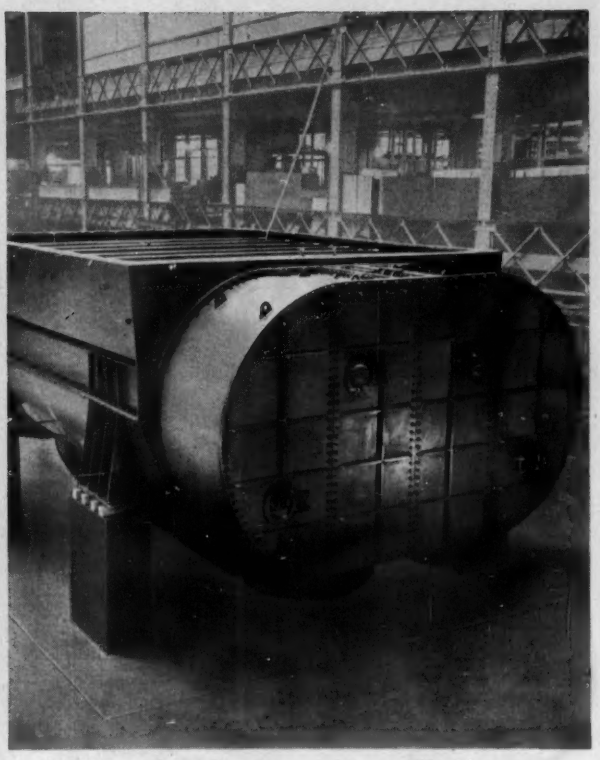
"One more to show you. This forced draft fan is driven by a 450 hp, 1180 rpm E-M Induction Motor with an E-M Magnetic Drive to adjust speed. E-M cage construction is practically indestructible. And rugged E-M rotors are balanced precisely for vibration-free operation!"







One of 28 Worthington condensers serving 20,000 kw turbine generator units in a southern aluminum plant. Each unit has twin 9300 sq. ft. shells, tee-connected.



100,000 sq. ft. low-headroom oval-type Worthington condenser. One of five units serving 215,000 kw turbine generators at the largest power plant in Ohio.

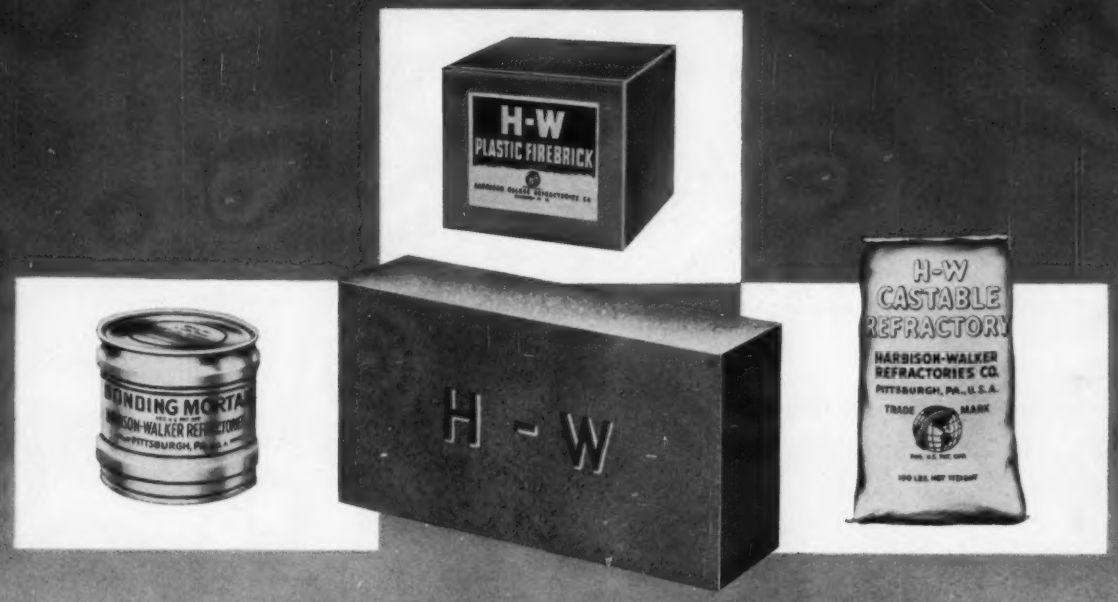
Name the job... Name the space... WORTHINGTON has the condenser!

Worthington builds condensers in all sizes to meet any reasonable space requirement. A design exclusive . . . the Double Folded Tube Layer . . . enables Worthington to "tailor" a condenser to available space, reducing cost of foundation and building construction. Most headroom limitations are easily met. The Double Folded Tube Layer design is adaptable to almost any shape of condenser shell, without sacrificing efficient performance. Worthington offers a variety of arrangements including oval or rectangular single shell units, side mounted shells with exhaust elbow, twin shells with side or tee-piece exhaust connections, and special designs for "axial-flow" exhaust turbines. Worthington can meet your needs quickly and economically.

Contact your nearest Worthington District Office or write: Worthington Corporation, A&SP-Steam Power, Harrison, N. J.

WORTHINGTON

STEAM-JET EJECTORS • VACUUM PUMPS • BOILER FEED PUMPS • FEEDWATER DEAERATORS • SURFACE CONDENSERS and AUXILIARIES • STEAM TURBINES



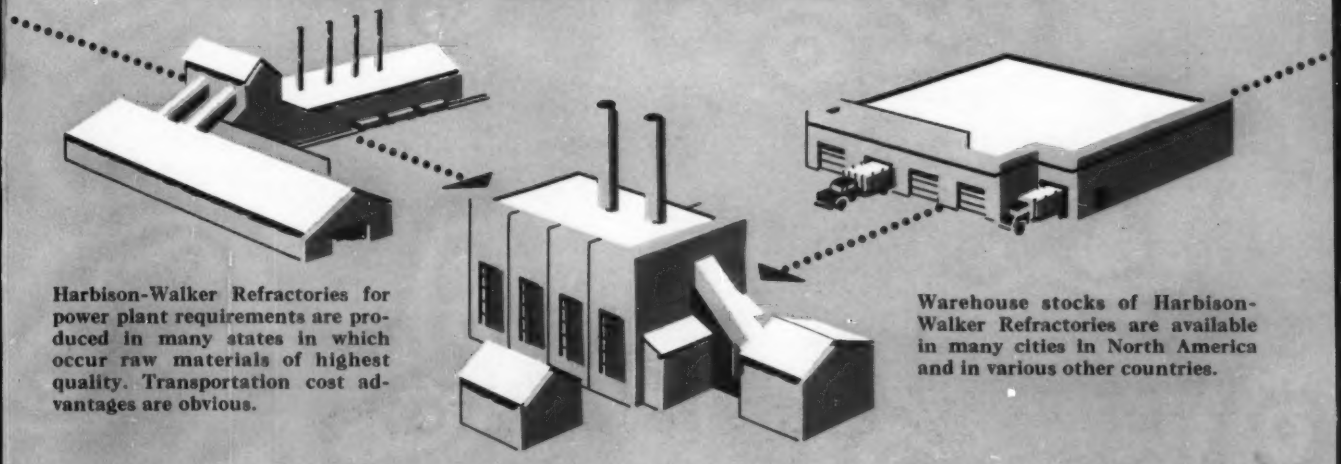
HARBISON-WALKER

REFRACTORIES

for every type of boiler furnace . . .

for every fuel . . .

AVAILABLE NEARBY



Harbison-Walker Refractories for power plant requirements are produced in many states in which occur raw materials of highest quality. Transportation cost advantages are obvious.

Warehouse stocks of Harbison-Walker Refractories are available in many cities in North America and in various other countries.

REFRACTORIES FOR ALL REQUIREMENTS. To meet the wide variety of operating conditions that exist in steam power generating plants, Harbison-Walker provides a complete line of refractories from which can be selected the exact types and brands for the most economical service.

Continued next page

You can secure maximum economy

by using HARBISON-WALKER

REFRACTORIES

Harbison-Walker products include the many different kinds of refractories needed in boiler settings of every type and for all fuels and firing practices. These provide the kinds of refractories that give maximum service with best economy in each particular application.

Harbison-Walker Refractories are used to advantage in industrial and commercial plants, as well as in central power stations. Listed below are the principal types and classes of refractory products which are regularly used for boiler plant requirements.

Technical service based on the most extensive experience and research is freely offered for assistance in determining the refractories best suited for each specific requirement.

A Complete Line of Highest Quality Products

REFRACTORY BRICK

The various brands of Harbison-Walker refractory brick used for walls, bottoms, arches, stacks, ash pits and other service comprise all classes of fireclay and high-alumina refractories. Included in the full complement of products are all the different kinds of basic and silica brick.

PLASTIC REFRACTORIES

Harbison-Walker plastic refractories are widely used for the construction of arches, target walls, baffle walls, burner ports and irregular shapes, as well as for making quick and economical repairs. These plastic refractories are made in both standard and super-duty classes. They are easy to install with the various H-W anchors and form durable, one-piece structures. Plastic Thermolith Batch is a chrome refractory and because of its chemical composition and dense impervious texture when heated, gives outstanding service in bottoms of slag-tap boiler furnaces.

CASTABLE REFRACTORIES

The development of castable refractories in a dozen specialized classes has resulted in noteworthy economies in the construction of furnace linings of irregular design and in the forming of difficult special shapes. They are shipped in dry form and when mixed with water like concrete may be poured, tamped into place or applied by means of air placement guns.

Among the various kinds of Harbison-Walker castable refractories used in boiler plants are: standard and super-duty grades, extra strength, high alumina, chrome, and lightweight classes as well as baffle mix. The wide variety of these specialized castables provides for every particular need.

INSULATING REFRACTORIES

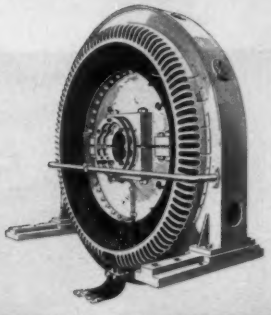
Harbison-Walker insulating fire brick are made in seven brands, each of which is suitable for use over specific temperature ranges. Used as backing for the dense refractories which are required to withstand extremely severe treatment, they conserve heat and reduce the weight of the furnace lining. In addition to the conventional and special brick shapes, Harbison-Walker insulating refractories are available in the form of lightweight castables, block insulation and mineral fiber coating material.

MORTARS

The bonding mortars for boiler furnace requirements should be selected as carefully as the refractories with which they are used. The choice depends upon the kind of refractory and the service conditions. Harbison-Walker produces both hot and cold-setting mortars of various compositions having special characteristics for specific applications. Harwaco Mastic is a specialized product having a consistency similar to stiff putty which makes it ideally suited for plastering with a trowel as for example, in sealing the V-shaped spaces at the exterior face of tangential tubes in water-wall boilers.

See other side

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
World's Largest Producer of Refractories
GENERAL OFFICES: PITTSBURGH 22, PENNSYLVANIA



HOW GENERAL ELECTRIC SYNCHRONOUS MOTORS REDUCE MAINTENANCE COSTS

AFTER WINDING OPERATION, NEW POLYEX COILS WILL BE VARNISHED TO SEAL OUT MOISTURE AND CORROSIVE OR ABRASIVE MATERIALS

New Polyex* coils increase motor life

Polyex insulated coils, a recent General Electric development, will greatly increase the life expectancy of large motors and substantially reduce maintenance requirements. Prior to being introduced into the manufacture of G-E motors, Polyex coils were subjected to numerous exacting tests to prove insulation characteristics. These tests showed that Polyex coils have many times the physical strength of conventional coils. Throughout the tests Polyex insulation retained its superior characteristics—even after being baked for thousands of hours at 125 C.

Twice the resistance of other coils to operating temperature changes, moisture, contamination and mechanical damage is possible because Polyex coils are insulated with polyester films and fibres which are treated with the newest hydrocarbon resins. This all-dielectric insulating system is possible because the latest technological developments of chemistry and engineering are combined with the practical skills of more than a half century of coil manufacture.

Polyex insulated coils are but the most recent development in General Electric's continuing efforts to provide a maximum in motor life and reduce motor maintenance to a minimum. For more information about General Electric motors, contact your Apparatus Sales Office. A sales engineer will be glad to explain the many other advantages of G-E low-speed synchronous motors. Write for Bulletin GEA-5332. Address Section 775-6, General Electric Company, Schenectady 5, New York.

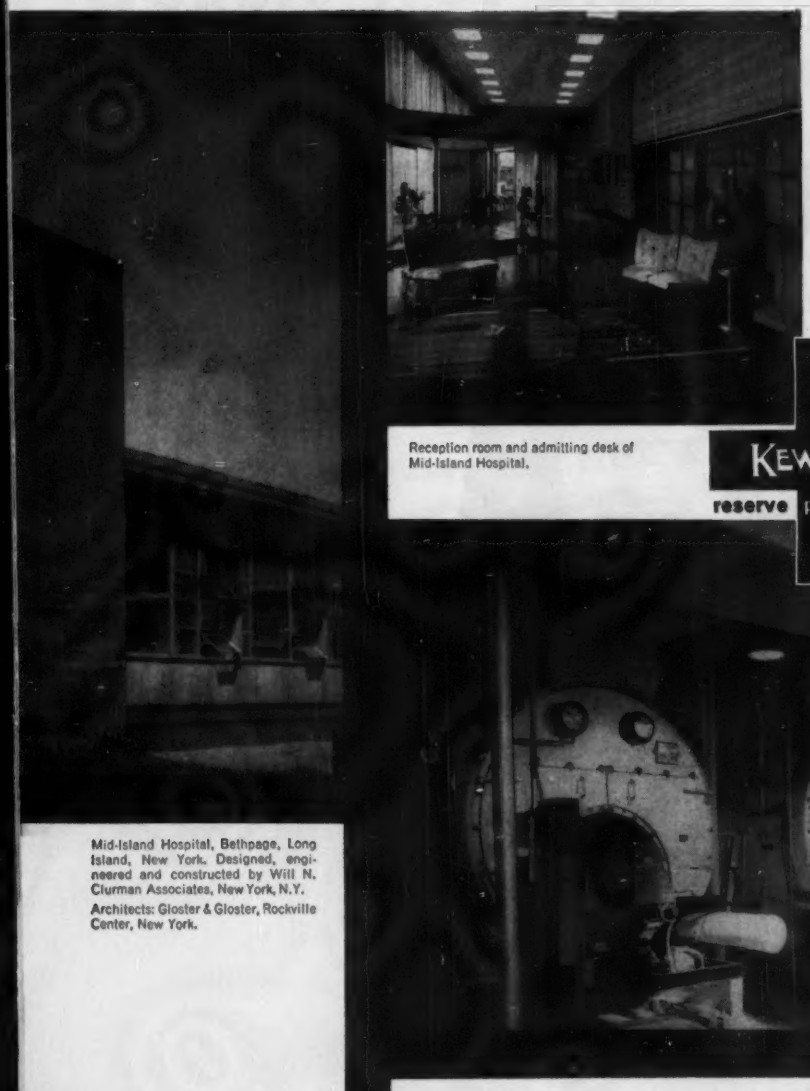
*Reg. Trade-mark of General Electric Co.

GENERAL ELECTRIC

KEWANEE "CRUISING PASSES CRITICAL

■ In a hospital there can't be the slightest margin of error. Nowhere else is equipment required to pass such critical tests. Mr. Howard A. Palestine, Manager of Mid-Island Hospital, Bethpage, Long Island, puts it this way: "Like all hospitals, ours operates 24 hours a day, 7 days a week . . . and we do it with the help of such dependable equipment as Kewanee Boilers. It was the reputation which KEWANEE has built up over the years which prompted us to specify that this type of boiler system be used." Rated on nominal capacity, Kewanee Reserve Plus Rated Boilers with 50% extra built-in power, fill normal requirements in stride. Yet, they can be stepped up instantly to produce additional power needed for emergencies—for fluctuating loads. They provide for expansion too. Here you get "cruising speed" boiler operation with greater efficiency—lower fuel and maintenance costs . . . less stress and strain, plus constant protection against breakdowns and repairs. There's no necessity to operate at full speed all the time. In addition, "cruising speed" operation means you get much longer boiler life. So select Kewanee Reserve Plus Rated Boilers. You can be sure of dependable service, with savings in money too. KEWANEE BOILER DIVISION OF AMERICAN-STANDARD, 101 Franklin Street, Kewanee, Illinois.

SPEED" BOILER OPERATION TEST AT MID-ISLAND HOSPITAL



Reception room and admitting desk of Mid-Island Hospital.

The spotless kitchen where appetizing meals are prepared.

KEWANEE

reserve plus rated

Here are five Kewanee Boiler-Burner Units which provide 'round the clock dependable service at Mid-Island Hospital.

Mid-Island Hospital, Bethpage, Long Island, New York. Designed, engineered and constructed by Will N. Clurman Associates, New York, N.Y.

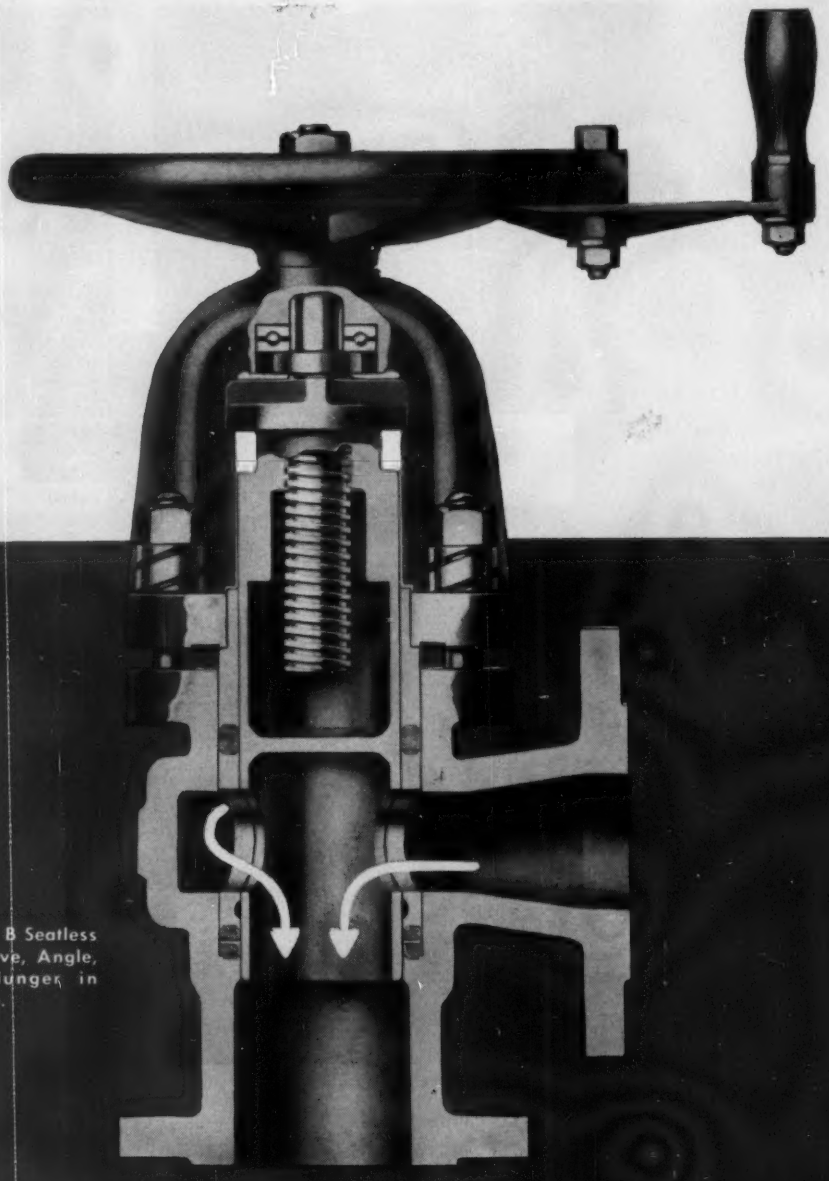
Architects: Gloster & Gloster, Rockville Center, New York.

AMERICAN-Standard

KEWANEE BOILER DIVISION

seatless

. . . for



Yarway Type B Seatless Blow-Off Valve, Angle, showing plunger in open position.

SEE THE YARWAY EXHIBIT IN BOOTH 532 AT POWER SHOW IN NEW YORK COLISEUM NOVEMBER 26-30.

YARWAY

trouble-free blow-down service

YARWAY SEATLESS BLOW-OFF VALVES

"Trouble preventers" is what YARWAY Seatless Blow-Off Valves are often called because they eliminate one of the commonest sources of trouble in low and medium pressure boiler blow-down service. *There is NO SEAT to score, wear, clog or leak.*

YARWAY Seatless Blow-Off Valves feature a balanced, sliding, hollow plunger design that permits free and easy operation—full, unobstructed flow.

More than 16,000 boiler plants today use YARWAY *Blow-Off Valves.*

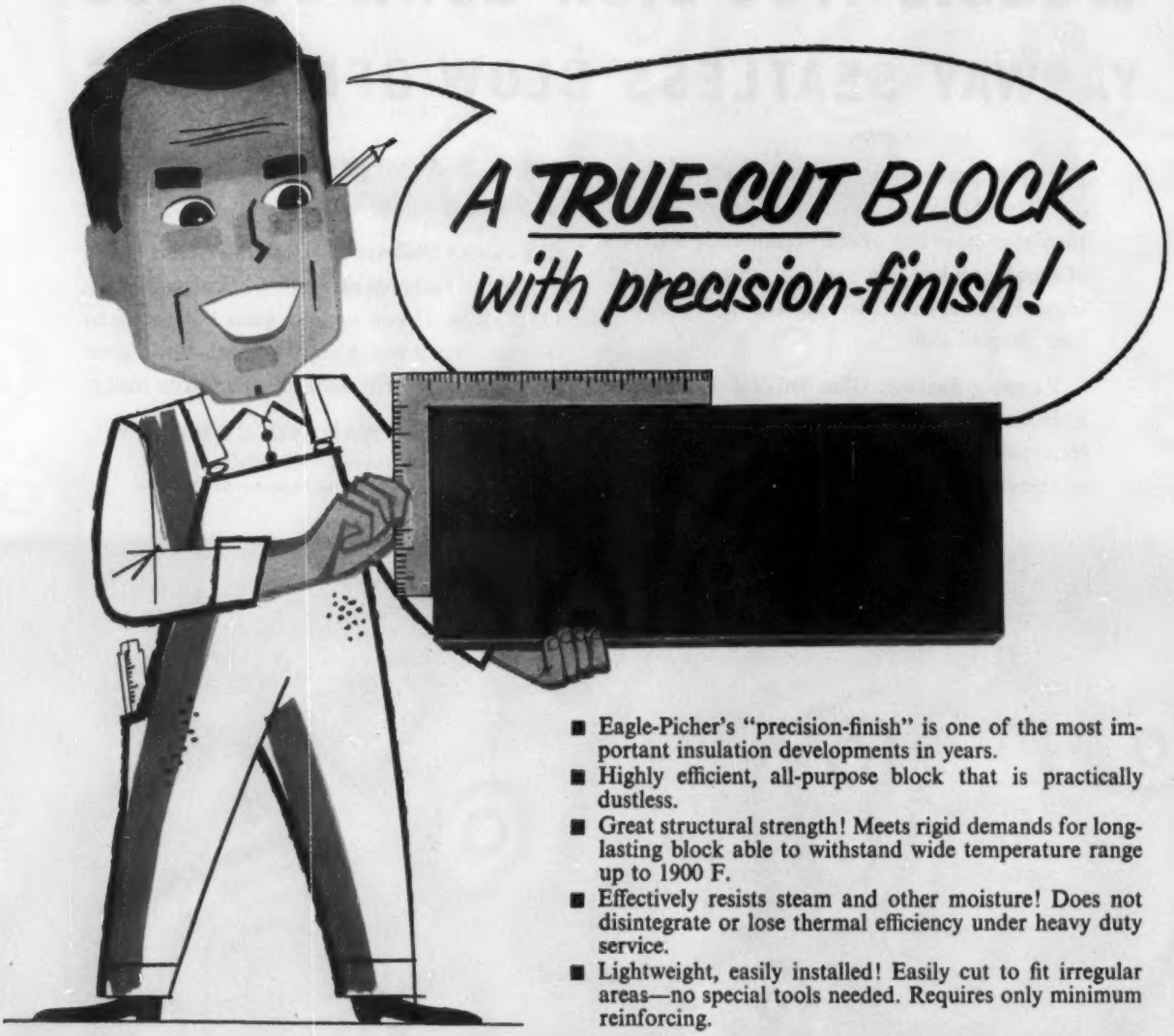
YARWAY Bulletin B-426 shows all the latest types and features of YARWAY Seatless Blow-Off Valves. If you operate your boilers up to 400 psi, you'll find a copy helpful. For higher pressures, ask for Bulletin B-434. Write today.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Type B Seatless Tandem Blow-Off Valve. Angle-angle combination. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Straightway. Pressures to 400 psi.
Yarway Type B Seatless Tandem Blow-Off Valve, Angle—Straightway. Pressures to 400 psi.
Yarway Type B Seatless Blow-Off Valve, Angle. Pressures to 400 psi.

— blow-off valves

EAGLE-PICHER
PV SUPERTEMP
BLOCK INSULATION



- Eagle-Picher's "precision-finish" is one of the most important insulation developments in years.
- Highly efficient, all-purpose block that is practically dustless.
- Great structural strength! Meets rigid demands for long-lasting block able to withstand wide temperature range up to 1900 F.
- Effectively resists steam and other moisture! Does not disintegrate or lose thermal efficiency under heavy duty service.
- Lightweight, easily installed! Easily cut to fit irregular areas—no special tools needed. Requires only minimum reinforcing.

FREE SAMPLE! WRITE TODAY! You'll sell yourself on the new "precision-finish" once you compare Eagle-Picher PV Supertemp Block to other insulating blocks.

(Member of Industrial Mineral Fiber Institute)

Since 1843

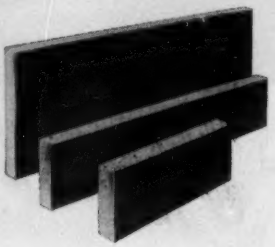
EAGLE EP PICHER

EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

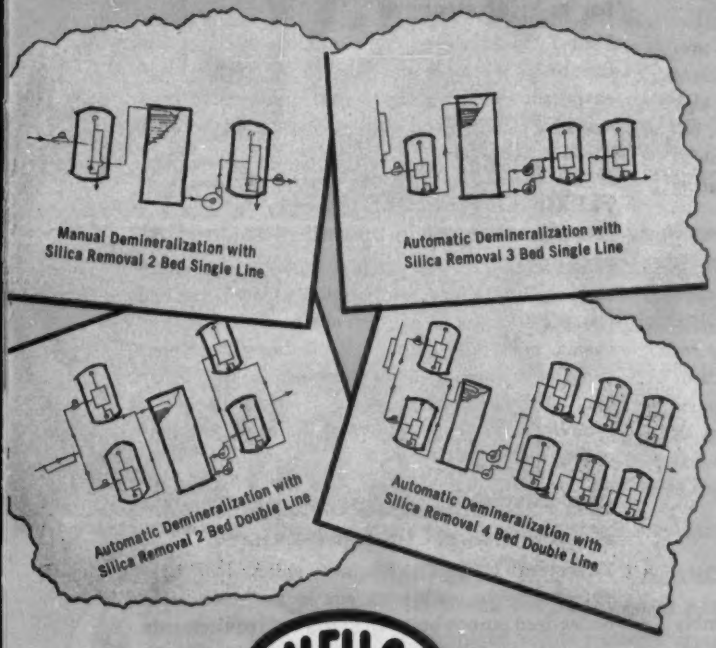
Mineral wool, magnesia and other insulations for all temperatures from below 0 F. to over 2000 F.

(Conforms to Commercial Standard CS 117)



*WHAT'S YOUR PROBLEM in DEMINERALIZATION

*INFILCO demineralizers are custom-built to solve the specific problems of each power plant


Manual Demineralization with Silica Removal 2 Bed Single Line
Automatic Demineralization with Silica Removal 3 Bed Single Line
Automatic Demineralization with Silica Removal 2 Bed Double Line
Automatic Demineralization with Silica Removal 4 Bed Double Line

*The one best design for equipment to demineralize boiler feed water make-up depends on the characteristics of the water to be treated, boiler pressure and design, quantity of make-up required and many other variables peculiar to each installation. The best solution for one plant may be a manually operated two-bed demineralizer; in other cases three-bed, four-bed or mixed-bed demineralizers—manual or automatic—may be indicated.

INFILCO furnished the *first* demineralization and silica removal equipment for treatment of high pressure boiler feed water make-up. Since that time, we have cooperated with Consulting Engineers in finding the best combinations of equipment and ion exchange resins for a wide variety of central station and industrial power plant requirements.

Let INFILCO help you realize the most kilowatts per dollar invested in demineralization. For more information see your Consulting Engineer or write for Bulletin 1960 C—PO-19.

Inquiries are also invited on all other water and waste treating problems including coagulation, precipitation, sedimentation, filtration, flotation, ion exchange and biological processes.

INFILCO

5619

The one company offering equipment for all types of water and waste treatment

INFILCO INC.

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NOW... you can obtain the advantages of the I-R UNIT-TYPE

Here's how the I-R Unit-Type rotor design contributes to dependable pump performance with minimum operating and maintenance expense.

HIGH EFFICIENCY— throughout years of operation

The simplicity of Unit-Type rotor design with precision-matched impellers and channel ring sections plus simple, direct fluid passages results in high operating efficiency. Efficiency stays high, too, because clearances are realistic and can be maintained without frequent replacement of wearing parts.

EASIER MAINTENANCE— and less of it

The Unit-Type rotor permits quick and easy removal of the entire rotor assembly without disturbing suction and discharge connections. All parts of the assembly are readily accessible, and easy to remove and reassemble. There are no shrink fits or delicate alignment problems.

GREATER INTERCHANGEABILITY— smaller spare parts inventory

Maximum interchangeability of rotor-assembly parts makes it unnecessary to stock separate replacement units for each individual stage. Except for the suction and discharge stages, impellers and channel rings are completely interchangeable.

SYMMETRICAL CASING— for greater strength

Unit-Type rotor assembly eliminates intricate hydraulic passages in the casing. The symmetrical casing provides greater strength, minimizes thermal distortion, and permits an attractive, streamlined exterior appearance.

FLEXIBILITY OF DESIGN— permits changes in operating conditions

Changes in operating conditions can be met easily by installing a new combination of impellers and channel rings on the original shaft...in the original casing. Forseeable changes in operating conditions can also be met by using "dummy" stages which can later be replaced by complete working assemblies. Unit-Type rotor design and smooth bore casing makes this possible.

FOR FURTHER INFORMATION— see your nearest I-R representative

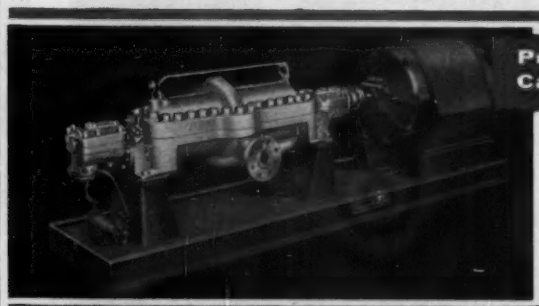
Your local I-R Sales Engineer will welcome the opportunity to work with you in the selection of boiler-feed pumps best suited to your requirements. Ask him to tell you about the latest advances Ingersoll-Rand has made in pumps for condenser circulating, condensate, heater drip and other power plant and central station services.

Ingersoll-Rand

10—440 **11 Broadway, New York 4, N. Y.**

ROTOR ASSEMBLY

in a complete line of boiler-feed pumps for pressures from 300 to 6500 psi

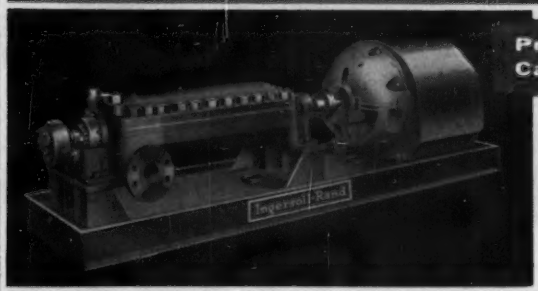


Pressures: 300 to 1000 psi
Capacities: to 700 gpm

Class CNTA

Recommended for medium pressure installations, the Ingersoll-Rand Class CNTA is today's most modern and efficient multi-stage boiler-feed pump in its pressure class.

It has a smooth-bore, symmetrical casing and features opposed impeller groups to neutralize axial thrust. Bearings can be either sleeve- or ball-type.

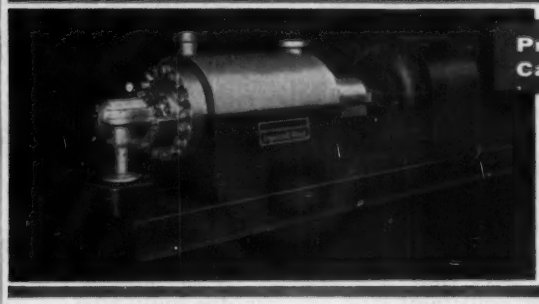


Pressures: to 1200 psi
Capacities: to 1600 gpm

Class HMTA and HMTB

I-R Class HMTA and HMTB multi-stage centrifugal pumps feature a symmetrical, horizontally-split casing and "in-line" staging.

Supplied in from 3 to 9 stages, they are widely installed as boiler-feed pumps in central stations and industrial plants. Ball- or sleeve-type bearings are available.



Pressures: to 6500 psi
Capacities: to 2800 gpm

Class CHTA and CHTB

Of the double-case design, Class CHTA and CHTB multi-stage centrifugals consist of a vertically-split inner assembly enclosed in a heavy cylindrical outer casing.

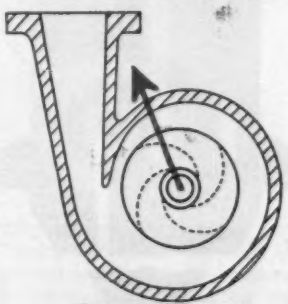
More of these Ingersoll-Rand pumps are installed in high-pressure boiler-feed service than any other make—indisputable proof of their overwhelming acceptance by modern central stations.

Thrust forces balanced with multiple-volute design

COMPLETE RADIAL BALANCE—a feature of all these I-R boiler-feed pumps

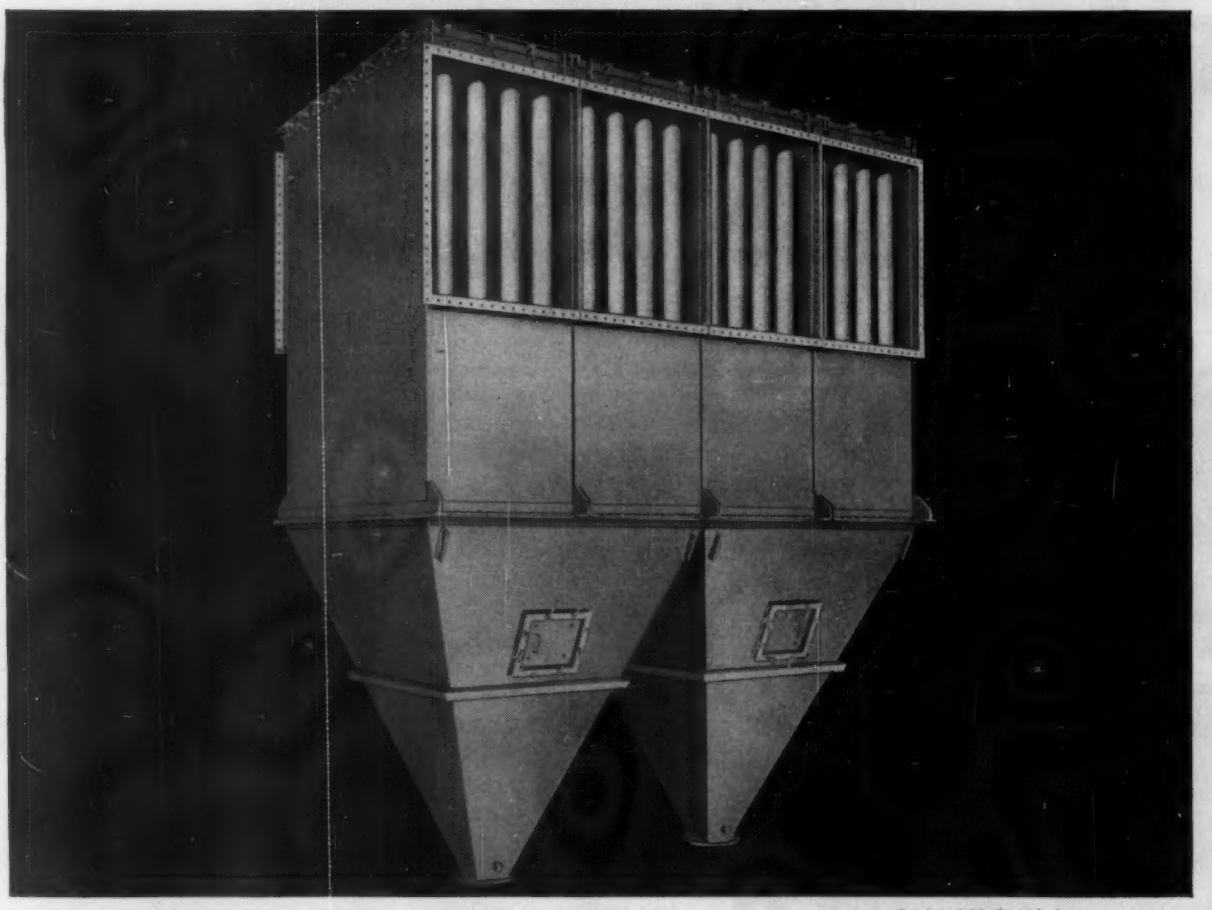
Evenly spaced volute passages around the entire circumference of the impeller balance the radial thrust force. That is, the radial forces become equal in all directions with a zero resultant on the impeller.

With a single volute casing, a radial thrust force is created due to the uneven pressure distribution around the periphery of the impeller. This force tends to deflect the shaft and cause the rings to rub with a loss in efficiency.

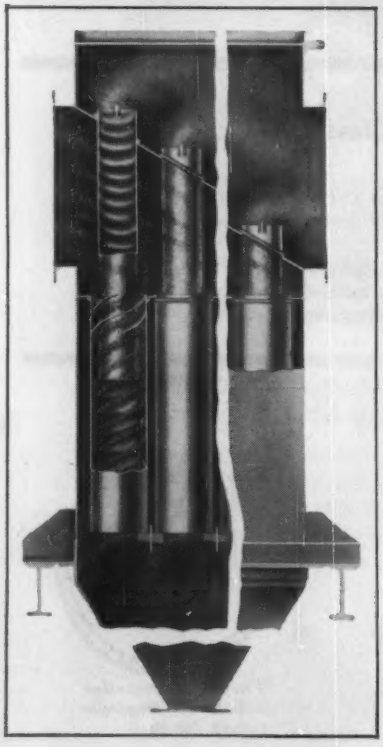


Thrust on impeller unbalanced in single volute design

Control fly ash with job-fitted



Series 342 Precipitator



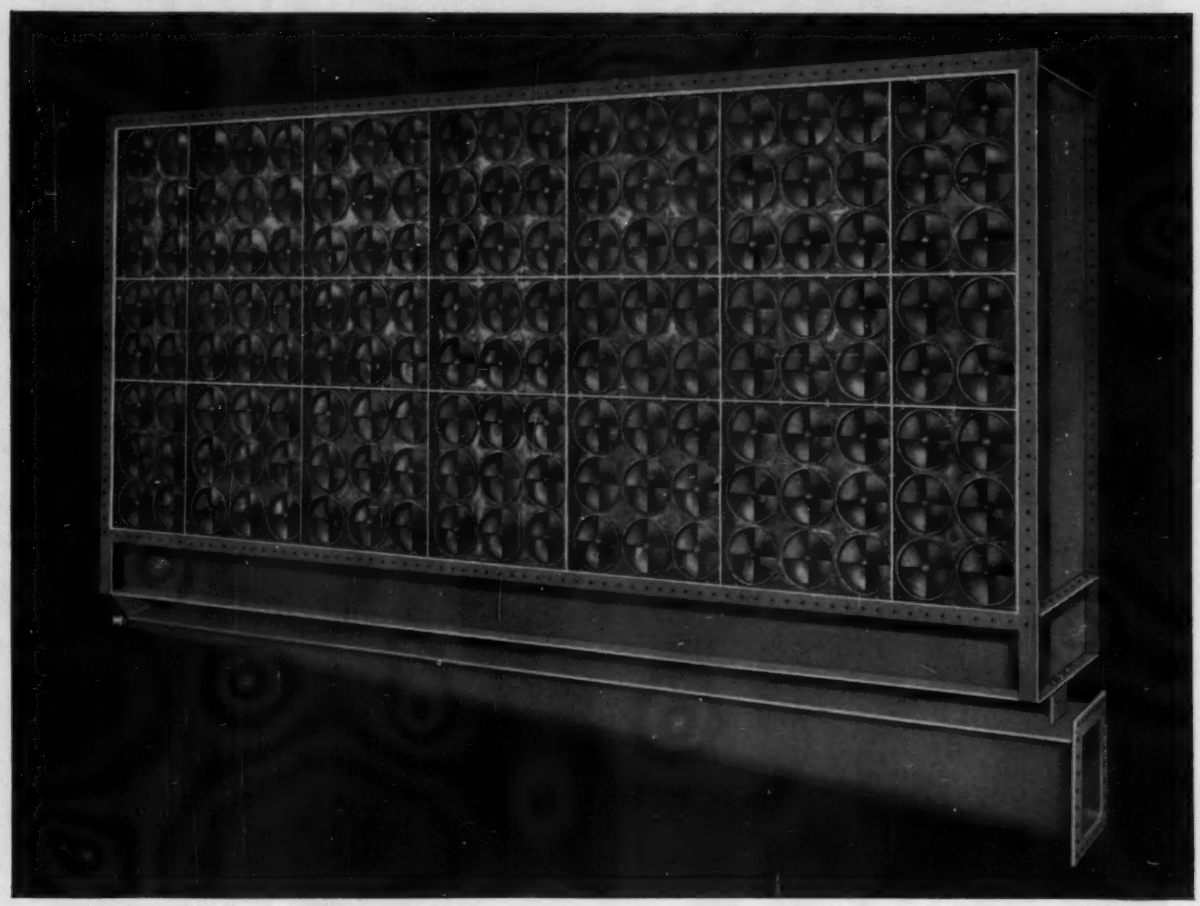
COMPACT DUST COLLECTOR – Series 342 Precipitator meets industry's need for a simple, compact, economical, all-purpose, mechanical-type dust collector. With the growing value of fly ash as a salable by-product, adequate, efficient collection is becoming increasingly important.

Easy to install because of its sectionalized construction, the Series 342 Precipitator has proved effective in controlling dust discharge to the atmosphere in a large percentage of industrial plants. The reason: since each tube assembly is basically an individual cyclone or centrifugal dust collector, the multi-tube Series 342 will deliver an over-all performance comparable to the high efficiency obtained by a single, small-diameter cyclone.

Furthermore, American Blower Series 342 Precipitator features welded-steel construction and removable tubes, is available in a variety of sizes to meet specific job requirements on either new or existing installations.

Dust-laden air or gas enters inlet plenum; gravity and centrifugal action force dust downward, adjacent to tube wall; dust is skimmed into gas-tight receptacle; cleaned air or gas moves upward through outlet tubes to outlet plenum.

American Blower precipitators

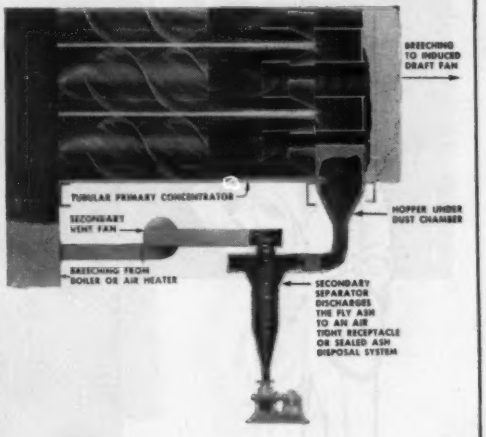


Series 361 Fly Ash Precipitator

FOR LARGE PUBLIC UTILITIES – Series 361 Fly Ash Precipitator offers maximum collection efficiency over entire operating range, occupies minimum space, and gives reliable performance, trouble-free operation.

What's more, the secondary separating system of the Series 361 makes it relatively more efficient at reduced loads when fly ash is finer and more difficult to remove. Then, too, ability to vary number and arrangement of individual cells makes it easy to tailor unit to the particular job.

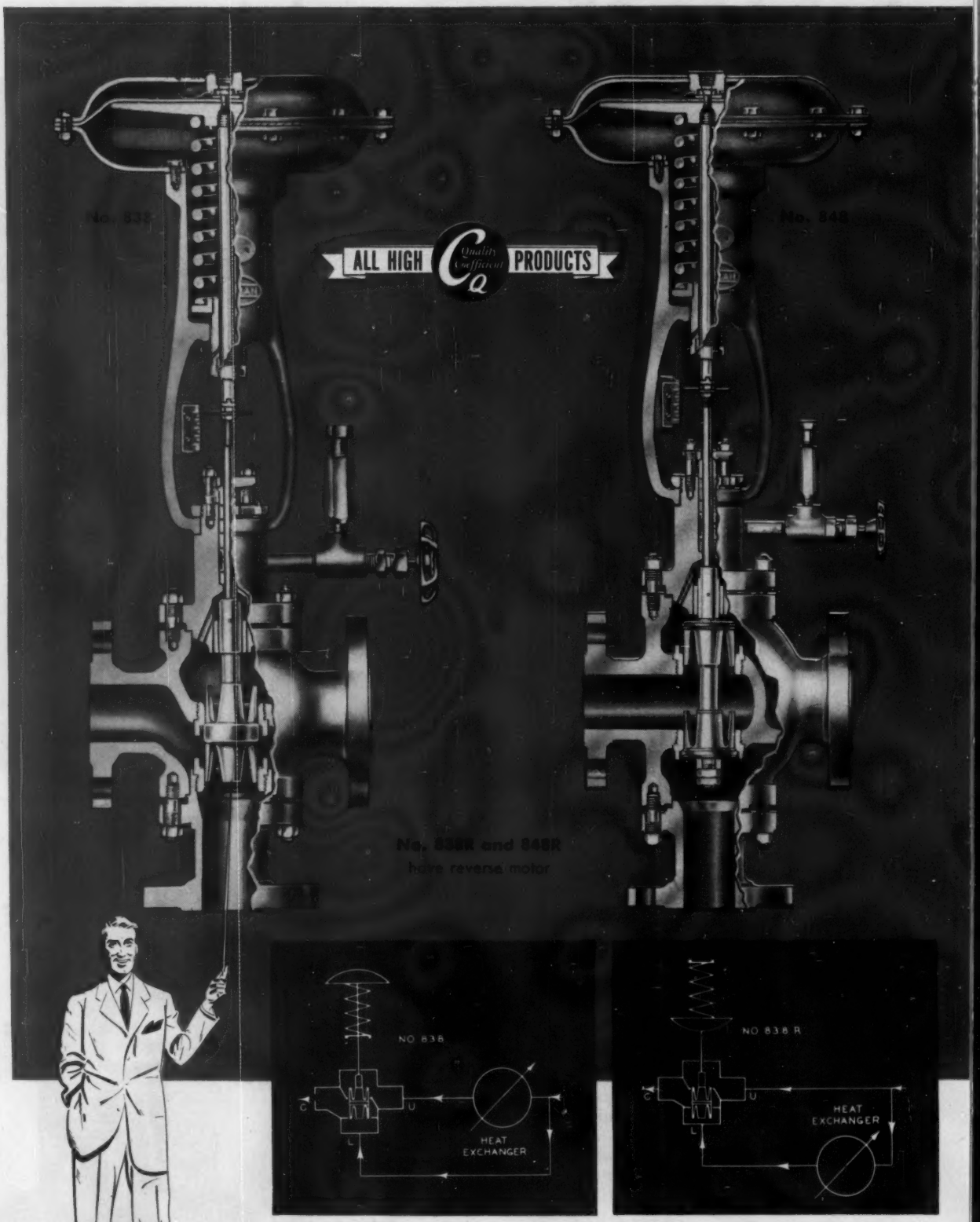
Whatever your dust-collection problem, it will pay you to talk to an American Blower engineer. His knowledge of the application of precipitators and dust collectors can prove invaluable to you. Call your nearest branch, or write: American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco products.


BREECHING TO INDUCED DRAFT FAN
TUBULAR PRIMARY CONCENTRATOR
SECONDARY VENT FAN
HOPPER UNDER DUST CHAMBER
BREECHING FROM BOILER OR AIR HEATER
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

Secondary system results in velocity-efficiency characteristics which automatically maintain maximum efficiency over entire boiler load or operating range. Properly installed and operated, unit's collection efficiency is from 85% to 90%.

AMERICAN BLOWER

Division of AMERICAN-Standard



Combining Service

In these typical applications of Masoneilan 3-way valves, No. 838 and 838R (above) are installed downstream of a heat exchanger for combining service; and No. 848 and 848R (shown on next page) are installed upstream for diverting service. In combining, the heating medium is brought in through ports U and L and out through common port C. In diverting, the fluid is brought in through port C and out through ports U and L.

Select Masoneilan 3-Way Control Valves to get...

Stability and Flexibility In Combining or Diverting Service

Choice of seating arrangement permits installation to obtain the inherent stability (and maximum allowable pressure drop) of flow tending to open both ports. No. 838 and 838R use a single seated body and a plug with seats back to back *inside* the seat rings. No. 848 and 848R use a modified double seated body and a plug with seats face to face *outside* the seat rings. Plugs are *top* and skirt guided for more accurate alignment and long service life.

Choice of motors permits obtaining maximum operating force, with same available thrust at both ends of the stroke or with a high thrust in one direction if desirable. 3-15 or 6-30 psi spring ranges and availability of oversize diaphragm cases allow a wide selection of motors, either direct or reverse. Enables you to choose, also, the action providing greatest safety factor in the event of air failure.

A more detailed discussion of these valves is available. Write our office nearest you, or

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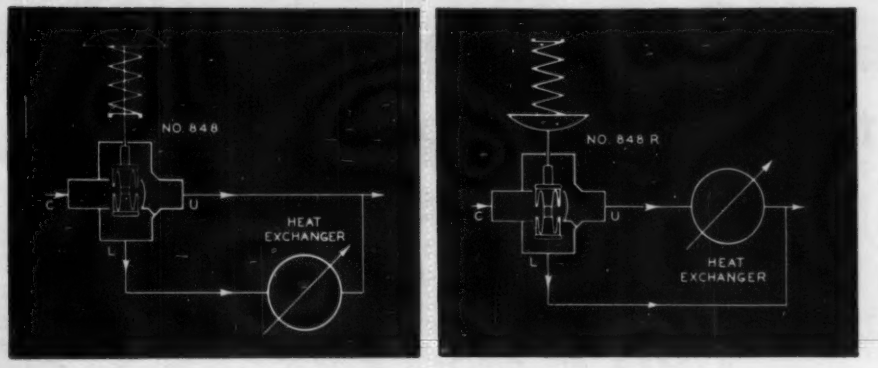
MASONEILAN

Division of Worthington Corporation

33 NAHATAN STREET, NORWOOD, MASSACHUSETTS

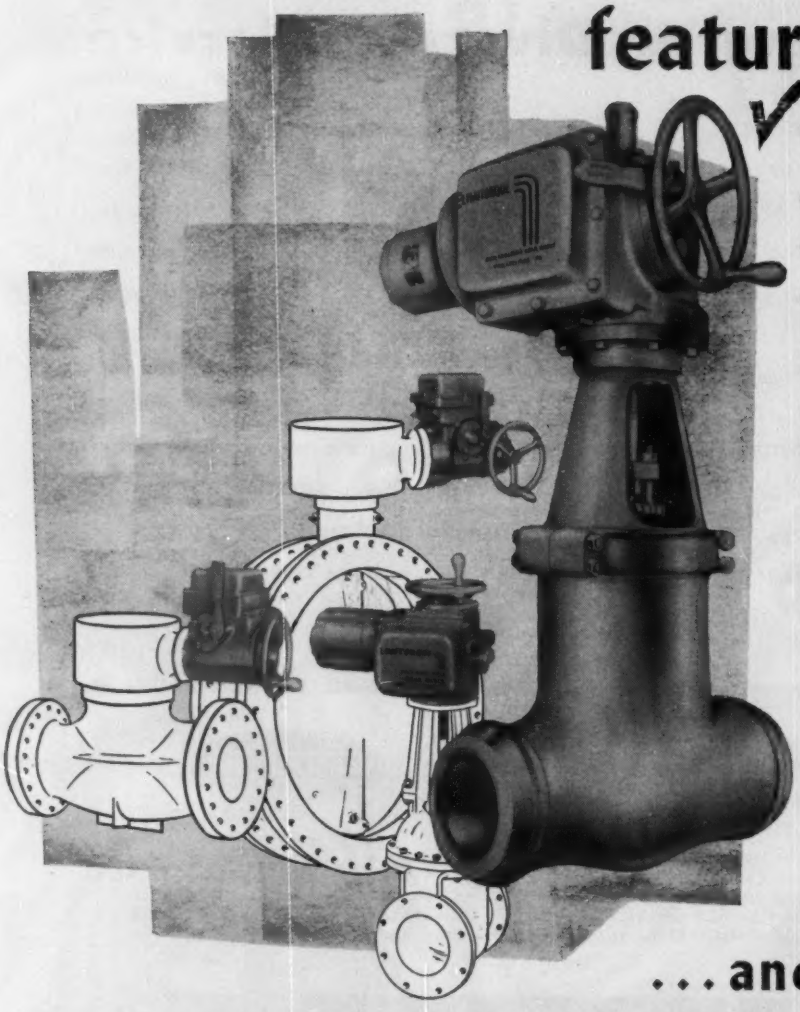
Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa Philadelphia • Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati • Kansas City • Phoenix Detroit • San Francisco • Louisville • Salt Lake City • El Paso • Albuquerque • Charlotte Los Angeles • Corpus Christi • Denver • Appleton • Birmingham • New Orleans • Seattle Mason-Neilan Regulator Co., Ltd., Montreal and Toronto



Diverting Service

Since maximum unbalance occurs across the bypass port, motor action is normally selected so that an increase in diaphragm pressure will tend to close the bypass port. The flow direction shown in all these diagrams tends to open both ports and maximum motor operating force is available to overcome off-balance. The valves are arranged so that the heating medium to the exchanger will be shut off in the event of air failure.

Check these features



- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight, watertight and explosion-proof construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96″ diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

. . . and you'll understand why more *LIMITORQUE* valve controls are in use than all others combined

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

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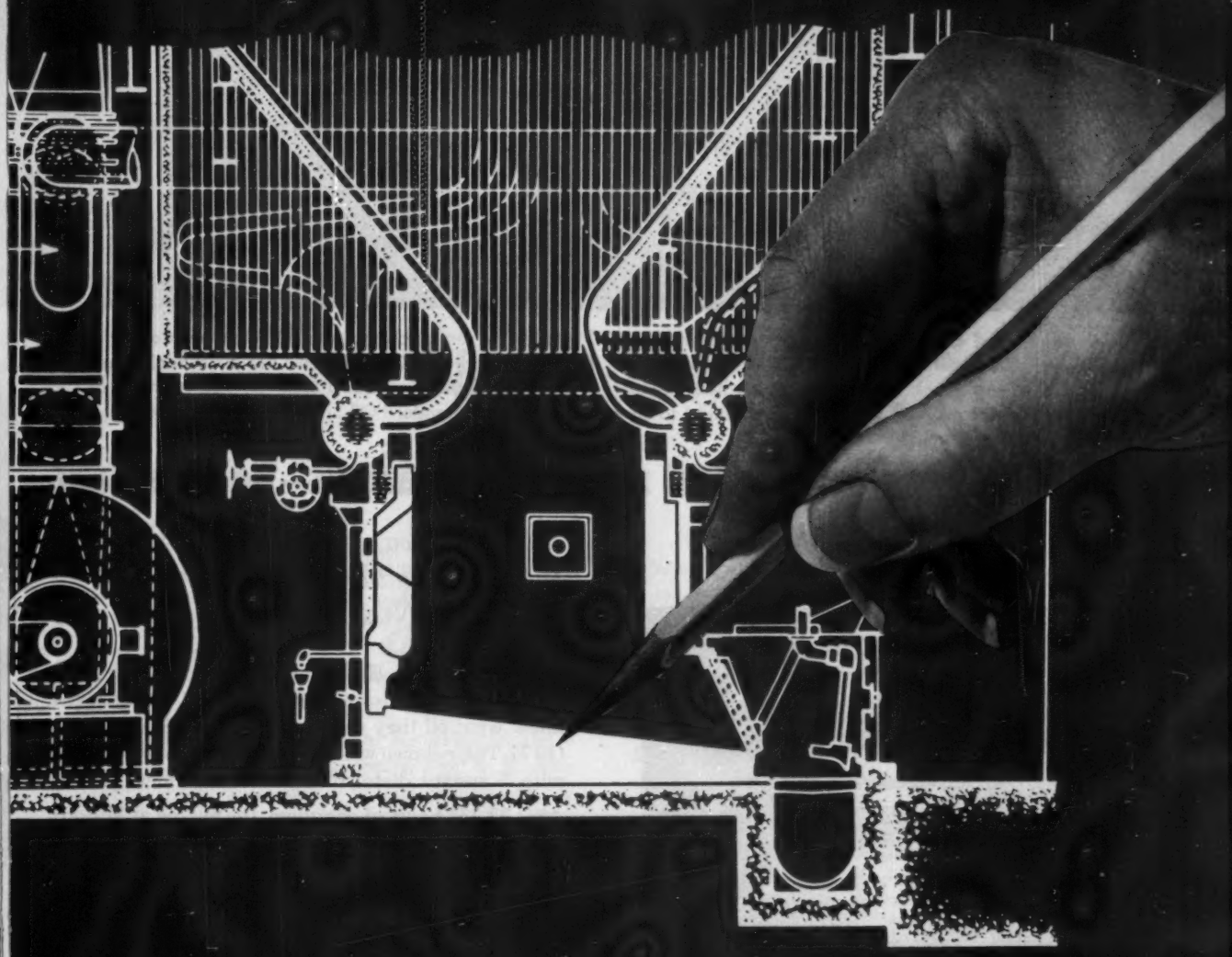
See the newest developments in Mechanical Power Transmission at our Booth #80—22nd National Power Show, New Coliseum, N. Y. C., Nov. 26-30.

How to draw the line on ashpit maintenance



"Let's put Kaocrete here"

Relining ashpits is expensive and time-consuming. That's why more and more utilities and industrial companies are specifying a heavy-duty refractory castable such as B&W Kaocrete D. On job after job, it has withstood the heavy abrasive or erosive attack of sprays, jets, rakes or shovels.

The reason? Specially designed Kaocrete D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It saves time because it can be poured or gunned into place. For less severe abrasive or erosive conditions, B&W recommends Kaocrete A.

Get the facts and figures on these B&W Refractory Castables from your local B&W Refractories Engineer.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
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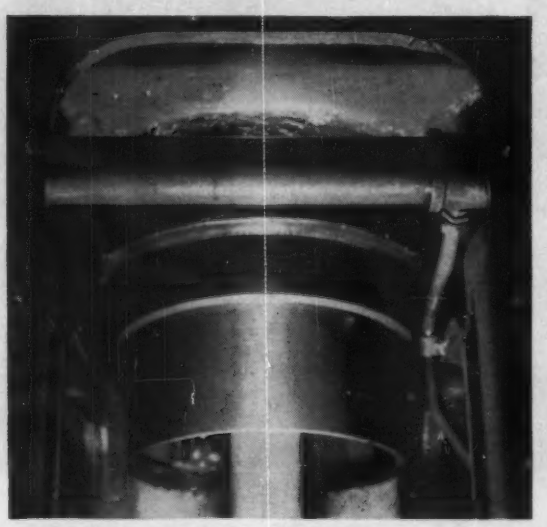
B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

R-34D

(l. to r.) Carl Olbertz, Milford plant superintendent, "Rollie" C. Bleimehl, Standard Oil industrial lubrication specialist and Frank Morgan, Milford chief engineer inspect crankcase. Rollie Bleimehl is qualified to give technical service on jobs like this. He's been doing this sort of work for 10 years. Rollie has a mechanical engineering degree from Iowa State College and has completed the Standard Oil Sales Engineering School.

23,000 hours on original rings and bearings—no overhaul

Milford, Iowa, Light Plant gets this performance from engine using STANODIESEL Oil M



"As is" photo of piston skirt and interior of crankcase. No wiping or cleaning was done before photographing or at any time during 23,232 hours engine has been in service. STANODIESEL Oil M is the lubricant.

When a new 720 H.P. Superior engine was put in service at Milford, Iowa in 1949, the plant management knew what oil they were going to use—STANODIESEL Oil M. Their choice was based on previous experience with Standard diesel oils in other engines.

After 23,232 hours of operation, the engine at Milford is still operating with the original bearings and rings. It has not been overhauled. The crankcase, as shown in the photo, is clean. Pistons are clean and bright with no sign of wear. Twice yearly, oil samples have been taken for laboratory analysis. Each time the analysis has shown the oil to be in perfect condition. Good maintenance and STANODIESEL Oil M have contributed to this performance.

Got a hard job for an oil? STANODIESEL Oil M can do it. STANODIESEL Oil M has superior stability. Its additive formula helps to (1) prevent oil viscosity build-up (2) keep crankcase, pistons, cylinder walls and other parts clean (3) control foam (4) maintain film on difficult to lubricate areas and parts.

There's a Standard Oil industrial lubrication specialist near you in any of the 15 Midwest or Rocky Mountain States. Call him for more information about STANODIESEL Oil M. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick facts about
STANODIESEL Oil M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by use of economy fuels.
- Maintains film on difficult to lubricate areas and parts.
- Eliminates spark plug fouling in spark ignited engines and reduces combustion chamber ash deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil commingle.

STANDARD OIL COMPANY
(Indiana)

STANDARD

LOUIS N ROWLEY, EDITOR • NOVEMBER 1956 • ESTABLISHED 1882 **Power**

The urge to grow

WE'VE been doing a lot of talking in these pages recently about *power to grow*. We've been referring, of course, to the design of industrial electrical systems—design that builds into such a system the ability to expand easily and economically.

Just a few weeks ago, at the annual convention of the Institute of Power Engineers, I got to thinking of the power-to-grow idea in terms of organizations and individuals. This meeting at Winnipeg, first for IPE in western Canada, demonstrated again that our engineer friends north of the border have the power to grow. Their association has advanced steadily in size and scope, has moved forward into new and greater areas of service to the field of power engineering.

Listening to their discussions, visiting their exhibit, chatting with individual members, I became aware of what seems to me an added dimension to the power-to-grow idea. And this added dimension is all-important in the development of organizations and of individuals. Here's why:

In engineering design, what we have called PTG planning is the provision of flexibility and capacity to take care of the larger loads the future will impose. Similarly, an association can plan its setup and program so it will be able to meet the demands of a greater future. And the individual can equip himself by education and training to be ready for opportunities ahead.

Now, in all these cases, a positive decision must be taken—a decision to plan for the growth that coming years may bring. In engineering design, the growth we plan for is largely the result of forces independent of our own activities. If the economy continues to expand, and if our company grows with it, we'll need more electrical capacity. Our decision then reduces itself to the relatively simple one of realizing the economic virtues of anticipating this growth.

When it comes to associations and individuals, forces outside ourselves are much less important. Growth comes from inside—but only if we want it and work for it. Here we need what I'd like to call the *urge to grow*.

It has been clear to me, from the beginning of my pleasant association with Canada's power engineers, that they have, individually and collectively, this urge to grow. They are devoted to building up the strength of the Institute of Power Engineers, and they realize fully and clearly that this can only come from the professional growth of each individual engineer. What's most important, they're doing something about it.

The IPE is, of course, just one example. If you look about, you'll find others, I'm sure. And from them, you'll conclude, as I have, that the *urge to grow* is the fundamental drive we all need to prepare ourselves and our professional associations for the great years that lie ahead.

The KENNEDY Pulverized Coal Firing System

SAVES per $3.00 OR MORE ton on coal costs!

ANY BOILER IS BETTER WHEN FIRED WITH KENNEDY PULVERIZERS. REPLACE YOUR PRESENT FIRING SYSTEM. BE PARTICULAR WHEN BUYING NEW BOILERS. INSIST ON KENNEDY PULVERIZERS.

Kennedy Pulverizers will pay you dividends:

In utilizing low priced coals

In low cost maintenance

In producing superfine coal for fast combustion

In availability...over 99%

In increased efficiency

In maintaining a clean furnace

In reducing losses out the smoke stack

Specify Kennedy Pulverizers for your next boiler...buy Kennedy Pulverizers for your present boiler.

IT COSTS LESS TO OWN THE BEST!

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Manufacturing and Engineering Corporation • Two Park Avenue, New York 16, N. Y. • Factory: Danville, Pa.

NO OTHER SYSTEM INCLUDES ALL OF THESE FEATURES...

UNBURNT CARBON LOSSES LESS THAN ½%.

FULLY AIR SWEPT

•

COAL PULVERIZED TO SUPERFINENESS

•

COAL COMPLETELY CARBURETED
Ready for Combustion

•

BIG TRUNNIONS FOR AIR SWEEPING

•

BALLS ADDED WITHOUT SHUTTING DOWN

•

LOW OPERATING AND MAINTENANCE COSTS

•

85% TO 90% THROUGH 200 MESH

•

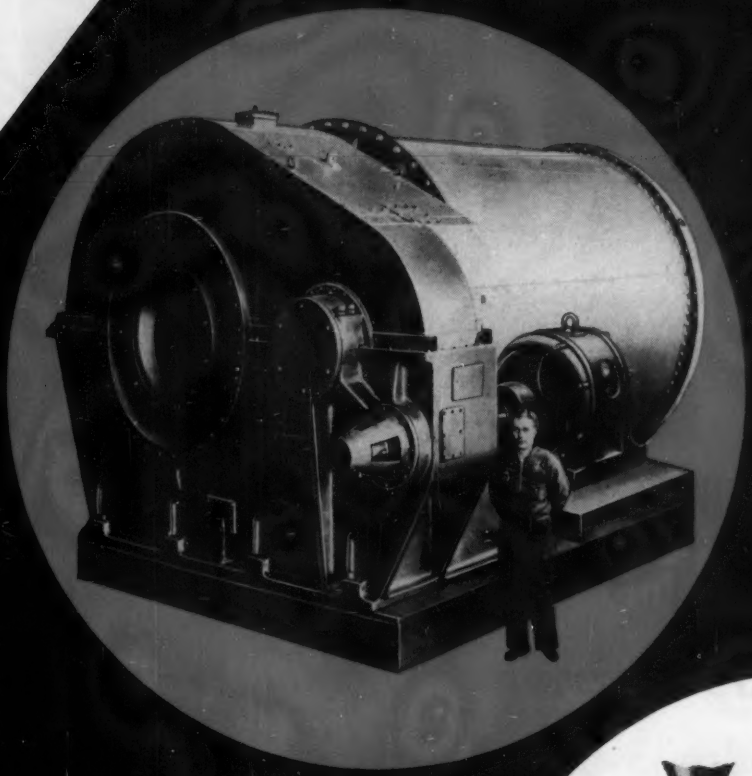
20% MOISTURE REMOVED WHILE PULVERIZING

•

PULVERIZES ANY COAL—BITUMINOUS, ANTHRACITE, FLUID COKE

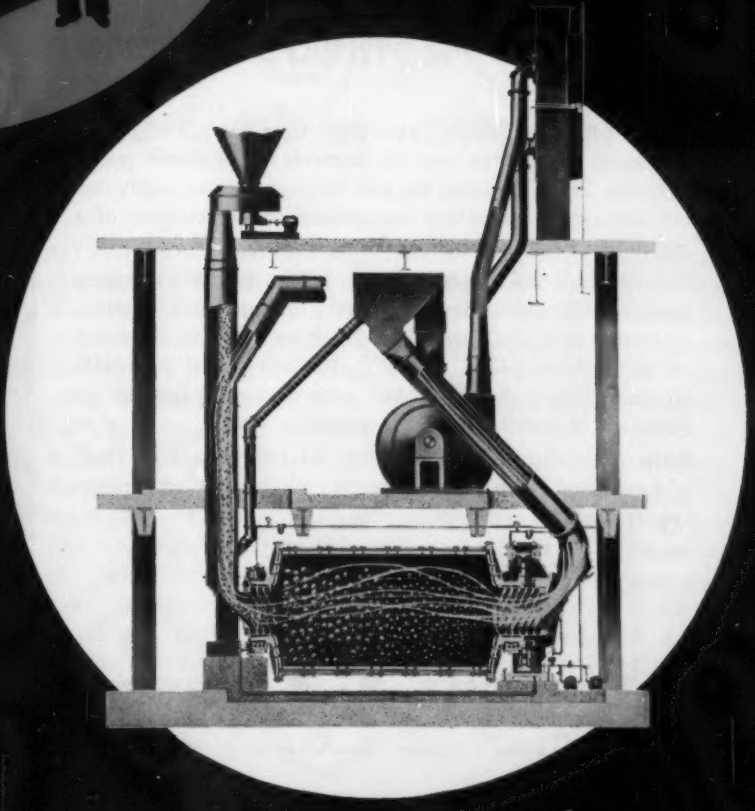
•

TRAMP IRON ACTUALLY AIDS IN PULVERIZING



AIR SWEPT TUBE MILL

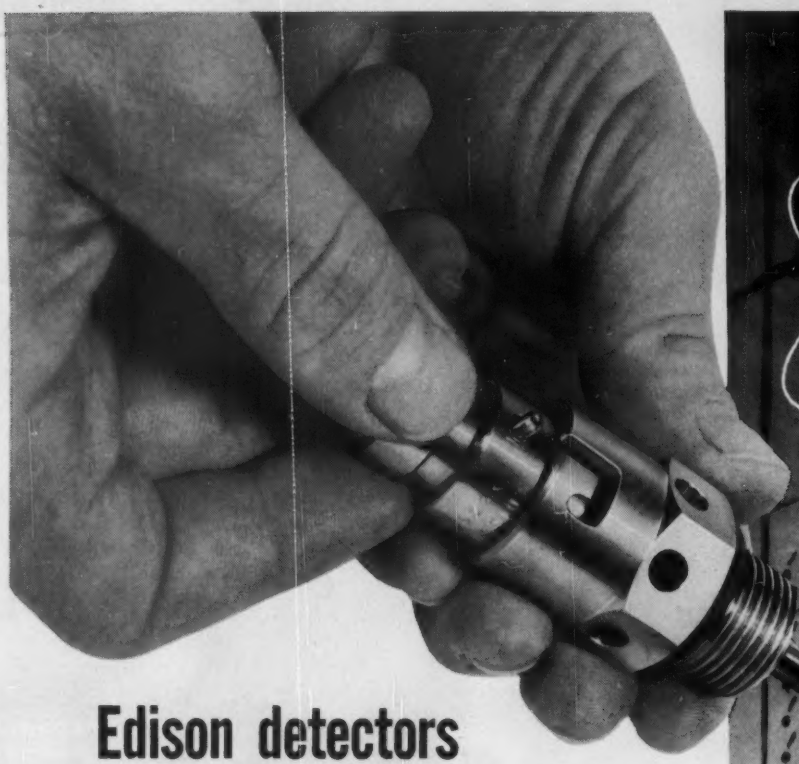
Slow-speed ball mill for perfect pulverization by air separation. Low-cost grinding of all grades of coal regardless of hardness. Grinding balls can be added without shutting down. Continuous year-to-year operation with better than 99% availability. Complete designs for steam and coal installations.



COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

ARE YOU PROFITING FROM ALL THESE ADVANTAGES?



Edison detectors give speedy warning of overheat in atomic pile

Self-monitor design assures fail safe operation

New Edison Resistance Temperature Detectors are especially developed to meet the exacting demands of the atomic power industry. These detectors are now helping forestall costly fuel cell damage by providing near-instantaneous detection of a rise in temperature in light water moderators.

Super reliable and simple in design, Edison detectors eliminate complex electronic components. Some are rated at 0.8 seconds maximum response time and the high temperature types give an accuracy of ±1.0% at 750°C. Radiation- and corrosion-resistant, Edison detectors have quick disconnect features for reduction of installation and maintenance time.

Write for Bulletins 3016 and 3036 for information on types of Resistance Temperature Detectors and remote temperature monitoring systems for every purpose.

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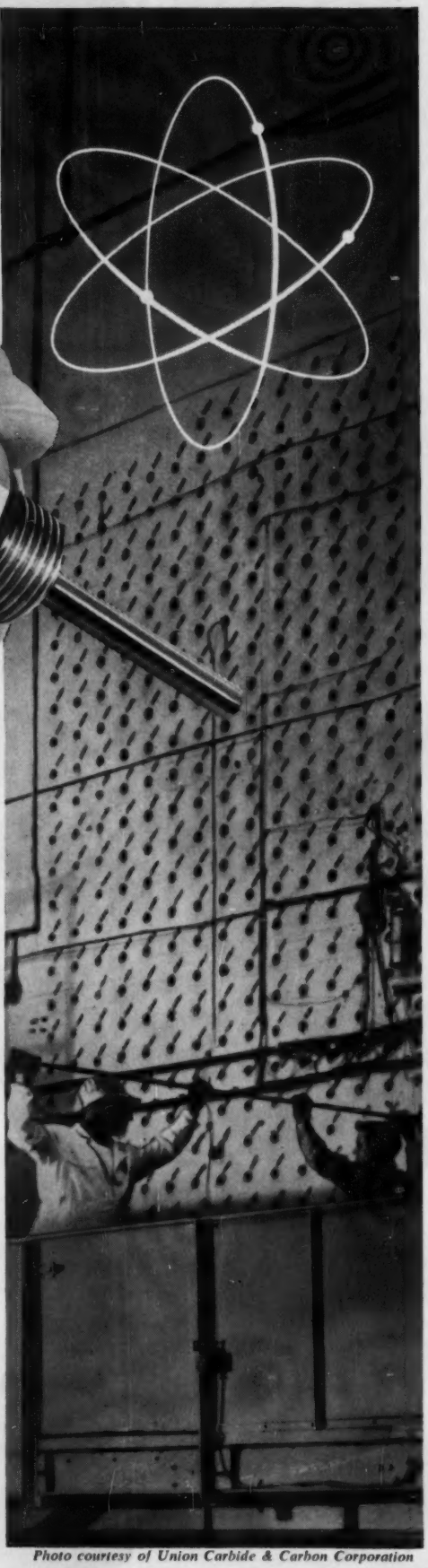
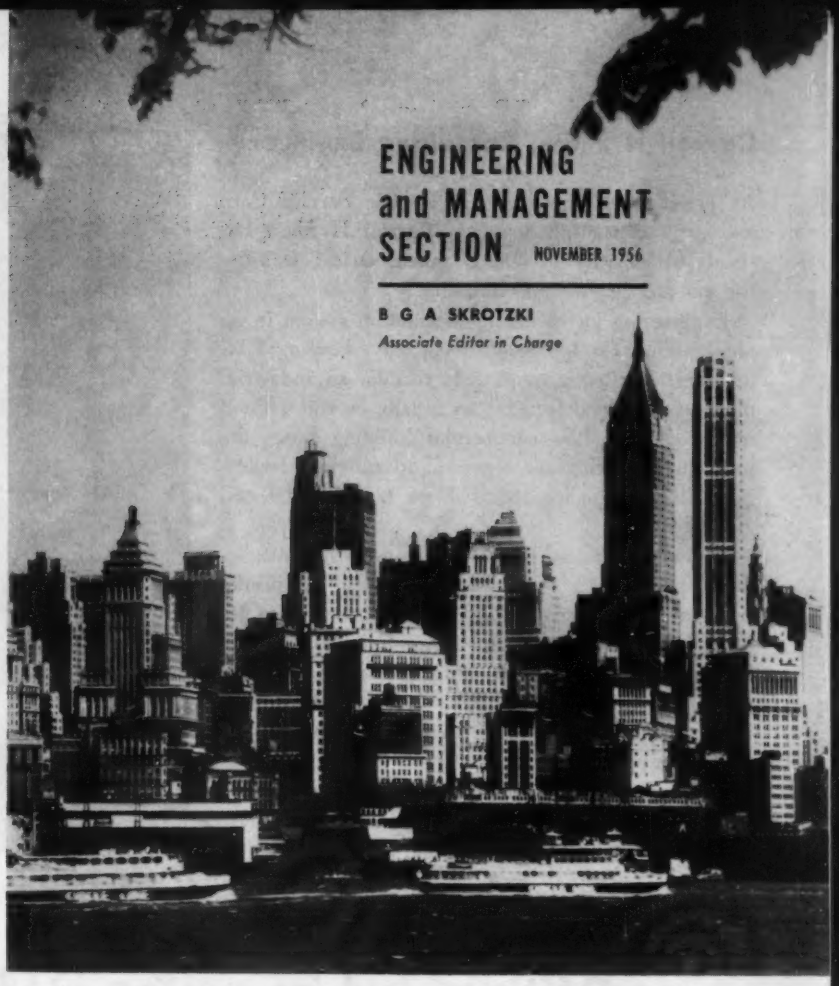


Photo courtesy of Union Carbide & Carbon Corporation



Power to grow ...electrically

No. 3: COMMERCIAL BUILDINGS

PTG in commercial buildings: an answer to the climb in watts per sq ft

► WHAT TOMORROW'S LOADS will be in commercial buildings and institutions is hard to predict. But one thing we can be sure of—they will be bigger. This third article in the Power to Grow . . . *electrically* series focuses attention on the electrical needs in old and new buildings. Since the commercial building—whether designed for manufacturing or straight office space—is generally a multi-tenant structure, the electrical planning operation takes on a different hue when stacked alongside the industrial plant. One reason is the fact that the building owner is but indirectly concerned with tenant production.

If you're involved in the design, operation or maintenance of commercial buildings, you probably are aware of the pressing need for better electrical planning. In recognition of this need, the National Adequate Wiring Bureau has recently announced their plan to launch a major program aimed at the commercial and institutional building field. In step with this program, POWER editors outline here some of the problems faced in N.Y.C. buildings and what's being done to solve them.

Turn page ▶

Carroll H Shaw, Consulting Engineer

As president of the National Electric Service Corp and as a consulting engineer, Carroll H Shaw has spent many years designing new electrical facilities for existing commercial buildings.

Engineering an electrical distribution system in an old building for higher load capacity, keeping PTG in mind, is often a tough job. Unlike an industrial plant where added feeders can usually be run without major changes, the commercial building poses the problem of getting space needed to run new feeders in addition to space required for transformers and switchgear.

One approach used by Shaw is shown schematically, facing page. Here, an existing feeder with RH insulation was reused at about double its former capacity by simply increasing riser voltage from 208 to 480. Incoming service from the utility company remained at 120/208-v 3-ph 4-wire. Riser insulation was found in good condition to operate safely at more than double the former voltage.

Photos below, taken from Con Edison files, show several ways to handle the problem of getting more electrical capacity to higher floors.

Office machines, air conditioning, lighting

Sitting comfortably at his desk in one of lower New York City's older office buildings, Carroll H Shaw, Consulting Engineer, brought the commercial-building electrical power question into seasoned perspective with the comment, "If top men have the *will* to plan ahead —they're on their way to having PTG."

It's Shaw's belief that need for PTG is most pronounced in older commercial buildings. Rapid growth in load concentration (higher lighting levels, business machines, air conditioning) plus difficulty in finding room to run new risers or to locate new switchgear and transformers, back Shaw's observation.

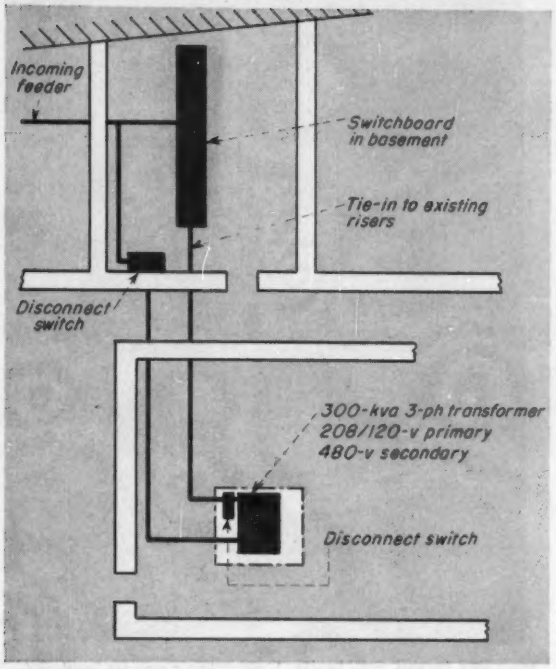
The commercial building in metropolitan areas is usually a multi-tenant structure. Owner's responsibility is to get power to the tenant, who in turn handles his own distribution. PTG approach here is essentially the same as for industrial plants—plan for tomorrow while installing for today. Key thought being to install equipment that fits a master growth plan.

Unlike industrial plants the voltages are generally in the under 600-v class. However, some skyscrapers have risers in the 13-kv range for distribution to load centers throughout the building.

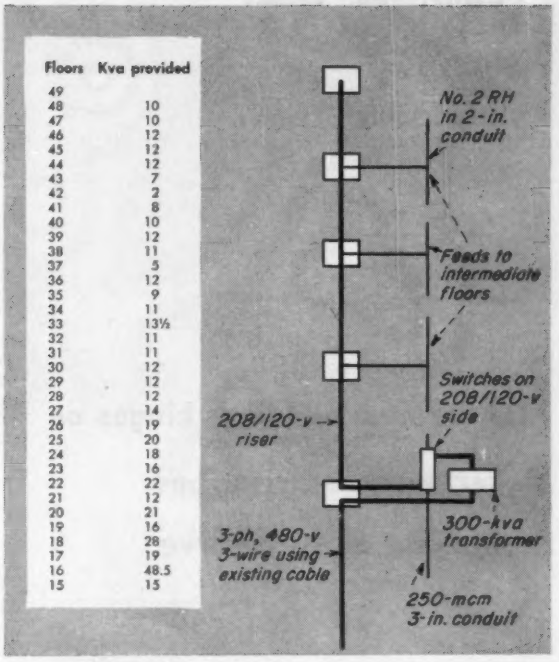
In any study aimed at meeting growing load needs in commercial buildings, consider the type of industry unique to the particular area. *Example:* In New York City there are districts for the needlework, fur, men's wear trades, plus financial areas and straight office building sections. Lighting levels, as well as power needs, will be based on the type of tenancy. Business machines, including modern computers, should be carefully considered in planning for growth.

Don't underestimate the potential load that computers may bring tomor-

Here's how three older New York City buildings solved their problem of



BASEMENT TRANSFORMER connected wye-delta, converts incoming 208 to 480 v for distribution. Higher voltage about doubles riser capacity: voltage stepped down at upper floors



VOLTAGE STEPDOWN takes place about midway in building riser. Remainder of riser operates at 120/208 v with taps taken at key points. Installation made at 30 Broad St, N.Y.C.

levels, prompt PTG action in old buildings

row. *Example:* A *Univac*, made by Sperry-Rand, accounts for a 125-kva load with its associated powerpac and computer. Business machinery often associated with a *Univac* and commonly called peripheral devices, is tape and card processing apparatus. Amount of this equipment varies. In a Con Edison *Univac* installation, peripheral devices alone amount to another 170-kva load.

At Con Edison, chilled water for cooling the *Univac* and its powerpac requires 31 tons of refrigeration. As a rough guide, Con Edison estimates that a *Univac* installation, complete with air conditioning and high-intensity lighting, will mean a load of 500 to 600 kva. Many commercial buildings could house several such installations.

Actual PTG design in modernizing a building may require (1) replacing conduit and cable risers with bus (2) running new conduit. Getting space to run new risers is often tough. Air, elevator and pipe shafts, washrooms, stair wells all must be carefully considered before running riser conduit outside the building.

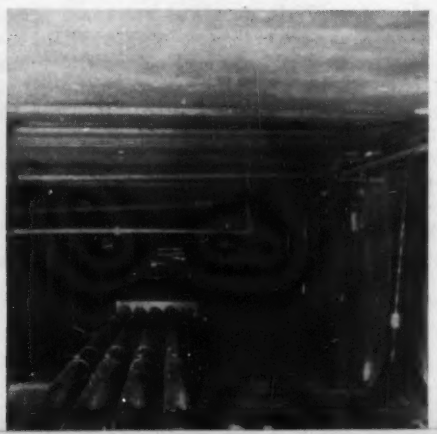
Rewiring for PTG will probably cost $50 to $70 per kva considering new entrance switchgear and risers. Where existing conduits are used, it's common practice to pull in new cables with thin TW insulation.

Recent growth picture in commercial buildings gives us a basis for planning. On the Con Edison system, 60 cycle load in Manhattan alone went from 538 mw in 1946 to 1107 mw eight years later. During the same period, the 25 cycle load dropped from 540 to 340 mw. This drop was due mainly to a reduced dc load.

What load magnitudes are we considering? In New York City the average watts of maximum demand per sq ft of rentable area in 1945 was about 3.4. This figure is based on data from 13 buildings erected before 1940. In 1954 alone, average demand in these 13 buildings leaped to 6 watts per sq ft.

Data from the Real Estate Board's survey of Manhattan office building construction shows about 100,000,000 sq ft of rentable office space existed at the end of World War II. New buildings, plus those under construction or being planned, will up that figure by 50%. Some of the newer projects are counting on 460/265-v service.

getting new risers to the upper floors



For PTG planning in new buildings, turn page →

Power to gro... ...electrically continued

PTG for new buildings hinges on higher voltages, riser-bus design and an IC reserve

SOCONY MOBIL BUILDING, Manhattan's newest landmark, is wired for 265/460 v. Among the engineering features are 32 operator-less elevators that can run at 500 to 1200 fpm

There's more to modern planning than simply meeting load needs. Often, coping with short-circuit currents is the major problem. Available short-circuit currents keep mounting as utility networks grow, posing the job of successfully interrupting a major short-circuit. With this in mind, electrical distribution techniques were given a new twist during the planning of the New York Coliseum, opened earlier this year.

Key design point in this building is current-limiting (C-L) busways and current-limiting fuses combined with molded-case breakers and more conventional busways. Combination was used with the aim of holding available short-circuit currents to a value that could be handled economically and safely.

Service entrance to the Coliseum is made up of four 3500-amp stubs. These stubs are supplied by a 265/460-v spot network consisting of six 2000-kva transformers. Because of high capacity and reduced effect of circuit impedance at 460 v, extremely high short-circuit levels are met at the entrance stubs. Actual value of the available short-circuit current at the stubs, including motor contributions, is about 186,000 amp asymmetrical. Because of this high figure, C-L busways were used between stubs and main switchboard reducing available current to 100,000 or less.

Physically, C-L busways are similar in appearance to the low-voltage-drop (L-V-D) type busways used throughout industry. The C-L busway or busduct has tapered copper or aluminum bus bars, 2 in. wide. Bars are arranged in widely spaced phase groups, producing the high reactance required.

Although physical appearance of the C-L busway is same as the L-V-D busduct, performance characteristics are radically different. Actually, the C-L bus tallies up a reactance figure from 8 to 23 times that of the L-V-D busway. In some ratings a 10-ft run of C-L busway sets up more reactance than a 200-ft run of standard L-V-D duct carrying the same rating.

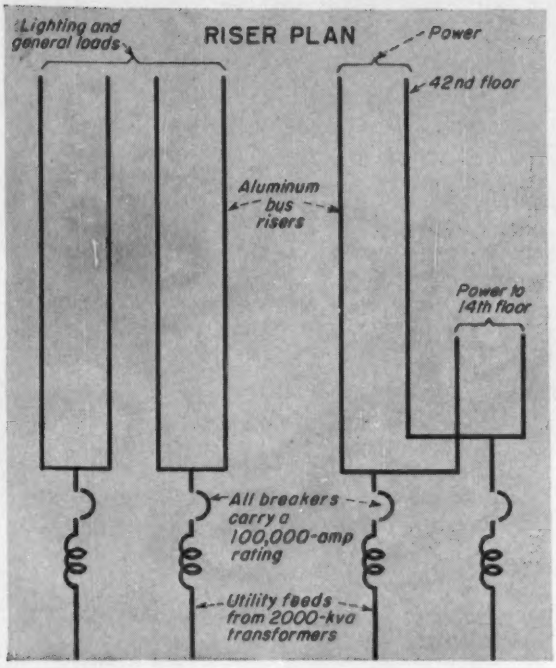
How is the high reactance achieved? Simply through use of relatively large geometrical mean distances between phase groups. *Example*: Impedance of a 4000-amp C-L busway is 0.0004 plus j0.0042 ohms per 100 ft, on a line-to-neutral basis. A feature of the C-L busway is the transposition straps which, in effect, reduce ac resistance by forcing main circuit currents to divide uniformly among the parallel bus bars within the enclosure.

High-reactance C-L busways were used from entrance stubs to switchboard in the Coliseum to cut back the 186,000 amps available. Alternatives were to use reactors, which are space consuming, or to design and brace the main switchboard for higher amperage levels. Switchgear design for the higher currents would, of necessity, include high-capacity air circuit breakers. Such breakers, if available, would be costly.

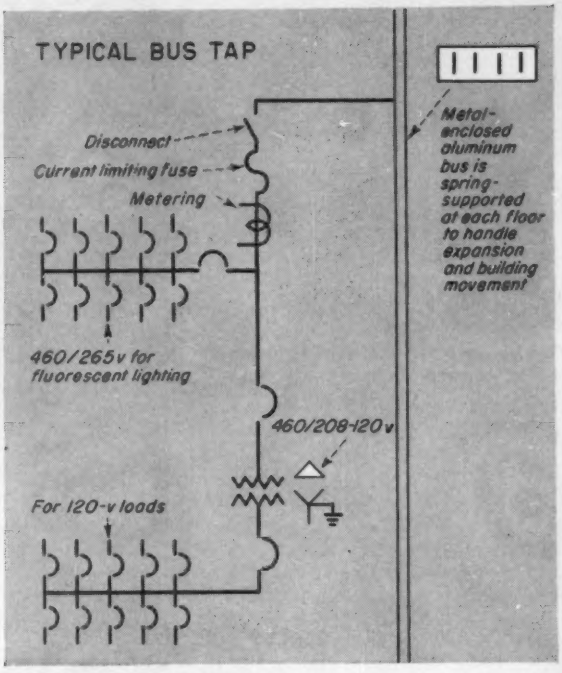
Within walking distance of the Coliseum, if you're a good walker, is the spanking-new Socony Mobil stainless-steel sheathed skyscraper. It carries with it a string of firsts: Largest air-conditioned commercial structure ever erected (POWER, October 1956, p 89); New York's biggest building in 25 years; first office building in Manhattan to be supplied with 265/460 volts.

Although the Socony Mobil structure is the newest, the office-building boom is moving at a fast pace throughout Manhattan. A check shows that in the last nine years some 60 structures with over 14,000,000 sq ft of rentable office space have been built. By the end of 1957, 14 more are scheduled for completion. And another 15 have filed plans. Demand keeps outracing supply.

Socony Mobil building was designed for an average lighting level of 50 foot-candles. This calls for a load of about 3 watts per sq ft. Auxiliary receptacle load comes to 1 watt per sq ft. This 4 watts per sq ft stacks up against an installed riser capacity of 6 watts per



ALUMINUM RISERS run up through closets on each floor. Reactors, to hold short-circuit current values in check, are in contrast to current-limiting bus used in Coliseum building


TYPICAL BUS TAP
Disconnect
Current limiting fuse
Metering
460/265 v for fluorescent lighting
460/208-120 v
For 120-v loads
Metal-enclosed aluminum bus is spring-supported at each floor to handle expansion and building movement

FLUORESCENT LIGHTING fed at 265 v; receptacles on each floor tap off dry-type transformer, step 460 to 120/208 v. Current-limiting fuses at disconnect protect panel breakers

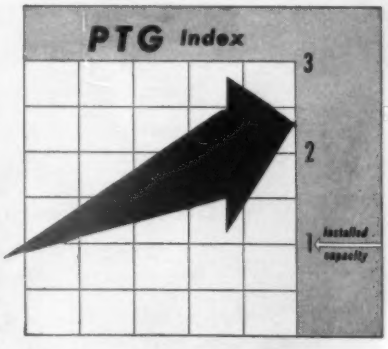
sq ft. Hence load can grow about 50% without need for additional risers. And, since the building is fully air conditioned, load growth will probably come in the form of higher lighting levels, and more office machines.

Risers consist of 4000-amp aluminum bus. Although schematic riser sketch, above, shows but four main circuit breakers, there are two other breakers handling the main distribution boards. Latter take care of concentrated and special loads like store lighting, basement machinery. In contrast to the Coliseum, available short-circuit current is limited here through use of reactors rather than C-L busway. The six 2000-kva transformers step the utility's 69 kv down to 265/460 v. They're located in concrete vaults under the sidewalks.

Even with a 50% load growth margin in the form of installed capacity, provision for further electrical growth was made by installing six 4-in. pipe sleeves in each riser closet throughout the building. These sleeves can accommodate cables if needed.

Electrical design was handled by the firm of Edward E Ashley; installation was made by Fishback & Moore Inc.

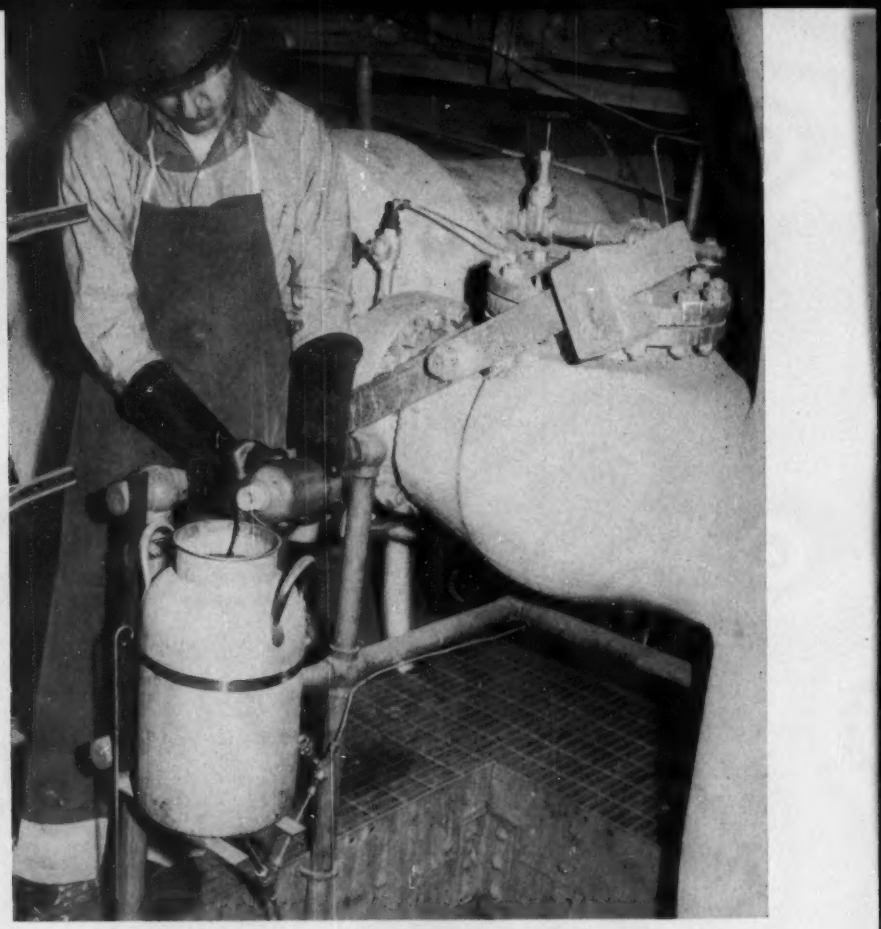
The PTG index: How big should it be?



By tagging the installed capacity as unity, the PTG index gives some measure of a system's expansibility. We define the power-to-grow area as the planned-for-capacity that can be economically provided and integrated into an existing system. And planned power-to-grow capacity divided by installed capacity is what we call the PTG index. It should serve as a practical guide for system planners.

The PTG index value, shown right, was selected simply to illustrate a point. Each article in this series will pin down the PTG practice in some particular plant. But when the cards are down, it's you alone who must decide the PTG index that is best suited for your plant. Knowing your industry will pay off here.

By ERIC R WOODWARD,
Chemical Engineer
Olin Mathieson Chemical Corp, Baltimore, Md



OPERATOR at Sewaren (New Jersey) generating station of Public Service Electric & Gas Company adds measured amount of hydrazine solution to main feed tank

If your problem is corrosion and total dissolved solids, the needed solution may be . . .

HYDRAZINE — for

What hydrazine solution is:

As a 35% solution of hydrazine in water, it's a clear, water-white alkaline liquid (1% solution has a pH of 9.9) with an ammonia-like odor. It contributes to desirable alkalinity and its reaction with dissolved oxygen is:

$$N_2H_4 + O_2 = 2H_2O + N_2$$
Hydrazine + Oxygen = Water + Nitrogen

End products are water and nitrogen, no solids. The nitrogen is evolved with the steam.

Compared with sodium sulfite:

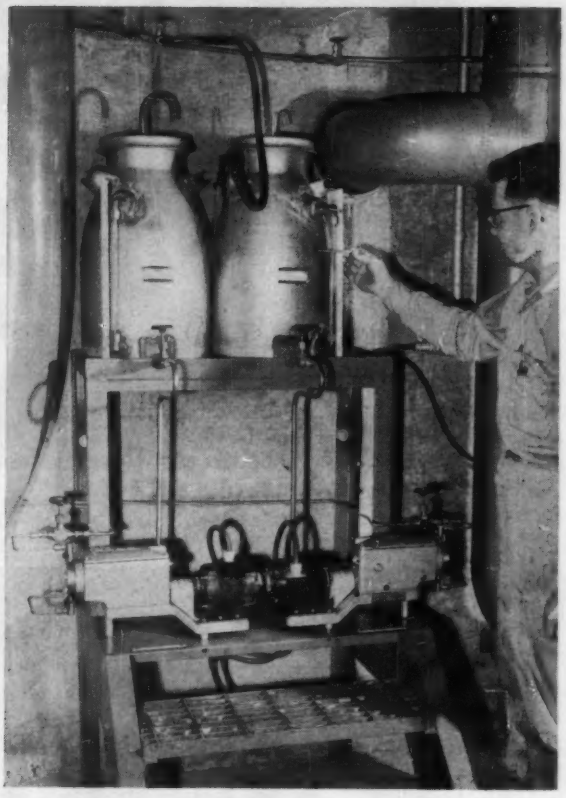
$$2Na_2SO_3 + O_2 = 2Na_2SO_4$$
Sodium sulfite + Oxygen = Sodium sulfate

End product is sodium sulfate—a solid. With common practice of feeding excess sulfite for complete deoxygenation of feedwater, some remains in original form—further adds to total dissolved solids.

► HYDRAZINE-TREATED boiler feedwater appears to be a big step forward in the search for the ideal treatment which would produce feedwater of slight alkalinity, zero-dissolved solids and complete absence of free oxygen. And, with today's steam generating equipment operating in supercritical pressure ranges, and demanding feedwater tailored to approach this ideal, hydrazine should play an important part in further reducing scale deposit and corrosion—cutting downtime.

Up-to-the-minute feedwater conditioning involves use of (1) chemicals to control acidity (2) evaporation or ion-exchange resins to remove dissolved solids (3) preheated feedwater with sodium sulfite added to reduce oxygen content. By and large, these methods do a pretty good job. But, in the area of oxygen removal—an area

LOW-PRESSURE heating boilers permit solution to be introduced by a double-valved pipe connection at top of boiler



LIQUID LEVEL of tank, feeding hydrazine solution to proportioning pump, is checked by operator in generating station

boiler-feedwater treatment

in which there's room for improvement —experimental work and actual operating results show hydrazine to have marked advantages over the traditional oxygen scavenger, sodium sulfite.

Hydrazine (N_2H_4) is a clear, water-white alkaline liquid with an ammonia-like odor. It reacts with oxygen (O_2) to form nitrogen (N_2) and water (H_2O). In boilers, the nitrogen is evolved with the steam.

Theoretically, one pound of hydrazine reacts with one pound of oxygen, but users find that less than one pound of hydrazine eliminates the corrosive effect of one pound of dissolved oxygen. (We'll discuss how this occurs a little later on.) Other advantages are: (1) Hydrazine doesn't add any dissolved solids either in its original form or through its reaction products. (2) Through partial breakdown to ammonia, it further contributes desired alkalinity to boiler water. (3) It requires less storage space and handling labor.

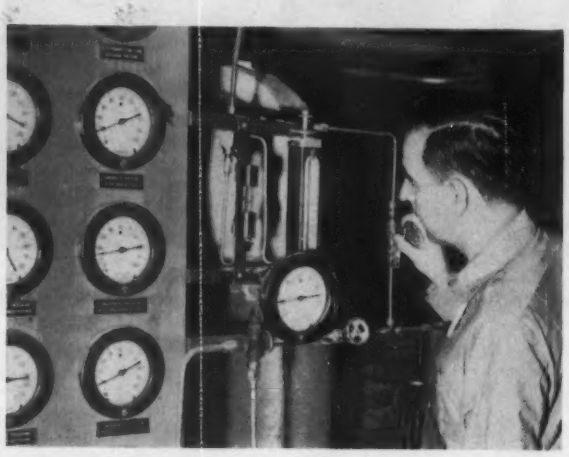
Sodium sulfite (Na_2SO_3), on the other hand, reacts with dissolved oxygen (O_2) to form sodium sulfate (Na_2SO_4) which, being a solid, adds to the total dissolved solids in the boiler. Considering that accepted practice is to feed excess sodium sulfite for complete deoxygenation of the feedwater, some remains in its original form and further adds to total dissolved solids. These tend to build a hard-to-remove coating on boiler tubes and drum surfaces and reduce boiler efficiency.

Hydrazine's efficiency as an oxygen scavenger cuts the amount of treatment needed. In theory, one pound of hydrazine will remove as much oxygen as eight pounds of sodium sulfite. In actual practice, though, it's customary to maintain a high sodium-sulfite residual in the boiler water. So it's reasonable to assume, that in some cases hydrazine could replace as much as fifty times its weight of sulfite.

The experience of our Brandenburg, Ky. plant illustrates what this might mean to industrial plants. Treating 4,600,000 lb of feedwater daily, the plant uses 76 lb of hydrazine a year. The same job previously done with sodium sulfite required handling and storing 3650 lb of the solid chemical a year with considerable labor cost.

Although the cost of hydrazine per pound is higher than that of some other water-treating chemicals, its effectiveness results in decreased treating cost. For example, the cost of feedwater treatment at our plants dropped almost 50% by switching from sodium sulfite

SIMPLICITY of storage, handling of Scav-Ox 35% hydrazine solution shown by operator drawing it from 30-gal drum



VALVE controls flow of solution to condensate pump. Boiler-water oxygen content determines amount of hydrazine needed

to hydrazine. This doesn't include savings from such factors as less corrosion, higher heat-transfer efficiency and less downtime for cleaning.

Hydrazine for boiler-feedwater treatment was first used in this country in 1951. By 1955, even though the treatment was still under development, some 44 utility plants, about 10 industrial plants and a number of apartment houses were regular users. The New Jersey Public Service Electric and Gas Company's Kearny station reports typical results. Here, hydrazine has been used in two new boilers for three years. The units are 1,000,000 lb per hr at 2350 psi, 1100-F total temperature and 1050-F reheat. They have pressurized furnaces, controlled circulation and gas recirculation. Feedwater is demineralized condensate from other boilers and contains oxygen at the condensate pump in the amount of 0.01 cc per liter. Recent inspection of both boilers showed only small amounts of iron-oxide sludge and traces of copper. Absence of corrosion is attributed to hydrazine treatment.

In general, users of hydrazine over the past several years in high-pressure boilers, 1350- to 2500-psi range, report that no disadvantages appear to exist. Principally because of this, hydrazine treatment is being considered by the Ohio Power Company for the new supercritical-pressure unit (first in the U.S.) going into service this fall at their Philo station.

Flammability was the big drawback for years and limited use of hydrazine as boiler-feedwater treatment to large consumers who could set up special handling precautions. But now, as a 35% solution in water, it has no flash point or fire point, yet retains hydrazine's oxygen scavenging and corrosion inhibition qualities. Too, the solution requires only the normal precautions used in handling any strong alkali.

Amount of hydrazine necessary for any given boiler depends, of course, on the amount of oxygen in the incoming feedwater. Without mechanical deaeration, the feedwater may contain up to 8-ppm dissolved oxygen. With efficient deaeration, oxygen content of the effluent may range from 0.005 up to 0.1 ppm depending upon the type of deaerator used.

Samples taken from deaerator discharge or from the feedwater pump discharge will determine oxygen content. The Winkler method is satisfactory when oxygen content is 0.04 ppm or more, but for lower values the ASTM D-888-49-T procedure is recommended.

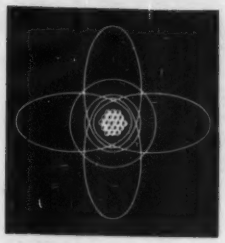
Hydrazine-solution feed for industrial-plant boilers usually involves a proportioning pump to inject the solution into the feedwater between the deaerator outlet and feedwater storage tank intake.

For low-pressure heating boilers, a double-valved piping connection to any convenient point above the water line permits easy application batchwise. Open the upper valve, pour correct amount of solution into the piping. Close the upper valve, open the lower one and the hydrazine drops into the boiler.

We said earlier that the actual amount of hydrazine required to eliminate oxygen usually is less than the theoretical pound for pound basis. This is true because hydrazine recirculation occurs to some extent in tight systems. After initial conditioning, the build-up of a hydrazine residual reduces needed dosage to less than the theoretical amount to afford protection from corrosion. Needless to say, boiler cleanliness has a direct effect—timewise—on establishing a residual.

Hydrazine residual can be measured rather simply. A color comparator is available that shows hydrazine content in fractional ppm, and the price is in line with those commonly used for measuring pH and chlorine.

Aside from the boiler-feedwater field, hydrazine solution shows promise for use in (1) laying up idle boilers in wet storage (2) laying up idle storage tanks and process equipment (3) closed-circuit cooling systems on stationary internal-combustion engines and compressors (4) hot water space heating systems (5) hydraulic testing of process equipment (6) water-circulating systems in nuclear reactors.



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Piqua, Ohio, hopes for 12.5-mw reactor plant have been boosted by AEC authorization of contract negotiations for initial design and development work. The reactor will use an organic fluid (the hydrocarbon terphenyl) as moderator and coolant and slightly enriched uranium as fuel. North American Aviation will develop reactor components and carry on pre-construction research. Piqua proposes that AEC finance and own $4 million reactor and assist post-construction development and research up to maximum of $3,600,000 and also waive fuel-use charges during contract period. Piqua would furnish land, buildings, turbine-generator, electrical equipment at cost of almost $4 million. Piqua would pay AEC for steam used from reactor and bear operating costs other than fuel. Piqua wants option to buy reactor after 5 years' use.

Nuclear-powered merchant ships will be developed jointly by AEC and Maritime Administration under Congressional authorization given in Public Law 848 on July 23, 1956. Congress appropriated $42.5 million for the job. First ship will have pressurized-water reactor with 15,000 to 25,000 shp capacity. Advantages of reactor-powered ships expected are: (1) They will carry larger cargo because power plant and fuel storage needs less space. (2) They will run longer at higher sustained speeds. (3) Eliminating many refuelings allows quicker turnaround. (4) Trade routes they can travel will not depend on foreign fueling stations. These advantages are expected to offset initial nuclear fuel cost of 70¢ per million Btu by increasing gross revenue and yielding bigger net returns. Oil costs for merchant ships now run about 35¢ per million Btu. Project includes six design feasibility studies; some are: closed-cycle gas turbine with gas-cooled reactor, organic-moderated and -cooled reactor, boiling-water reactor, super-pressure water reactor, aqueous homogeneous reactor.

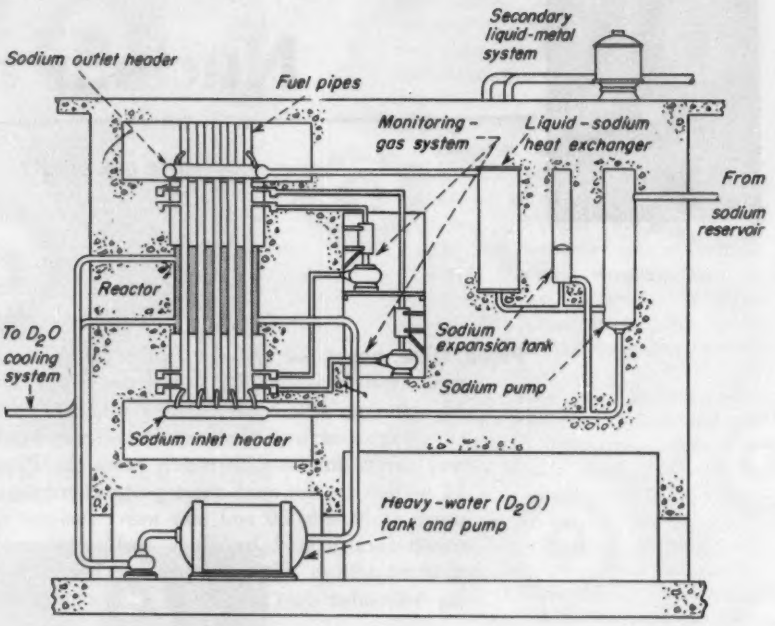
Nuclear reactors in the U.S.A. total at least 140 according to the Forum Memo, September 1956. This was estimated on the basis of 109 civilian reactors reported by L H Roddis of AEC. His list included reactors that were built and dismantled, reactors building, planned and "under consideration." The 140 include: plutonium-producing reactors at Hanford and Savannah River, the submarine prototypes and submarine power plants, ship reactors and prototypes, and aircraft units. The list also includes reactors built for foreign countries, 15 reactors for Aircraft Nuclear Propulsion Program.

Superheater for steam produced by the nuclear reactor in the Indian Point Plant, of the Consolidated Edison Co of N. Y., will be built by Foster Wheeler Corp. The oil-fired unit will cost $3.25 million and be built in two sections, each handling 1,075,000 lb steam per hr. Outlet temperature will be 1000 F.

U.S. Navy awarded a contract for a twin-reactor nuclear power plant for the first atomic cruiser to Westinghouse Electric Corp which is also developing and building the prototype power plant for the cruiser at Arco, Idaho. Reactors and related equipment will cost about $18 million. Cruiser will be built at Quincy, Mass., by the Bethlehem Steel Co.

Plutonium yields in future power reactors having U-238 in their cores are expected to vary from 200 grams plutonium per 1000 grams of U-235 burned to as high as 800 grams plutonium per 1000 grams of U-235 burned.

Longer fuel lifetime, flexible power range, higher temperatures promised by...



New sodium-deuterium reactor

► HEAVY WATER (deuterium) makes an ideal moderator for nuclear reactors but high cost has stood in the way of its extensive use. Liquid metals, particularly sodium, offer many advantages as coolants but have posed tough application problems. Now, in the opinion of engineers at Nuclear Development Corporation of America, the technology has advanced enough to make a sodium-deuterium reactor practical.

Advantages of such a design, they believe, would be:

1. Ability to use uranium as fuel, or, in units of less than 50,000 kw, uranium only slightly enriched in U-235.
2. Ability to build units for widely different power levels without radical change in basic design.
3. Ability to utilize to a high degree the fissionable material in fuel elements —both the original U-235 and the plutonium produced. This means higher burnup and longer fuel-element life. And the combination of low-enrichment fuels with high burnups opens the prospect of disposing of spent fuel elements without reprocessing, if reprocessing costs should remain higher than the value of recovered fuel.
4. Ability to deliver high-temperature heat without high pressures in the reactor system, and hence without heavy reactor pressure vessels.

Proposed plant. Jointly with Chugach Electric Association of Anchorage, Alaska, Nuclear Development Corp (known as NDA) has proposed a 10,000-kw plant of this type, as part of the Atomic Energy Commission's power-demonstration-reactor program. Just recently, AEC approved negotiation of a contract for limited design and development work on this project. AEC also authorized negotiation of contract provisions that would make it possible to proceed with other phases of the proposal calling for final development and engineering design, and for construction and operation, provided results of completed phases justify continuing.

SODIUM-DEUTERIUM DEVELOPMENT

Heavy water is available today for reactor use at $28 per lb—not cheap, but only a fraction of the cost some years ago. At Canada's Chalk River facility, at AEC's Savannah River plant, and at Argonne National Laboratories, valuable experience has been gained with deuterium as a moderator. Similar experience has been piled up in the use of liquid-metal coolants—by NDA, by North American Aviation, and at Knolls, Argonne and Oak Ridge labs.

In a sodium-deuterium reactor there must be a stable barrier between the two materials, which react violently if mixed. Advances in the metallurgy of stainless steels for reactor use give NDA engineers confidence that this problem can be solved without too great a sacrifice in neutron economy.

Compact design results from use of highly efficient coolant and particularly from the effectiveness of the heavy-water moderator. The job of any moderator is to slow down the neutrons released by fissioning U-235, thus increasing the probability of their capture by other U-235 nuclei and producing additional fissions. This slowing down results from collisions with atoms in the moderator. The number of neutrons absorbed by deuterium is only one-fourth the number absorbed by graphite. This results in more neutrons available to produce fission in U-235 and allows use of uranium with very low U-235 enrichment.

High neutron economy will, the designers believe, permit burnup of contained U-235 as high as 50%. A reactor of this type produces about three plutonium nuclei for each four U-235 fissions. It is expected that 25% of produced plutonium can be "burned."

Conceptual design for a sodium-deuterium reactor is sketched above. Reactor proper—a tank 6 to 8 ft in diameter—is at left. It contains a lattice of vertical pipes, in which are clusters of fuel elements and through which sodium coolant flows from bottom to top. Center portion of reactor tank, sealed off by partitions, holds the heavy-water moderator.

Main heavy-water circuit contains pump and tank below the reactor. Another circuit carries heavy water from the reactor to a heat exchanger and

to a cooling system, which keeps moderator at the low temperatures where it is most effective.

The fuel pipes, which will probably be about 4 in. outside diameter, are more complex than they appear. In each pipe a central stainless-steel tube contains a cluster of thin fuel rods; sodium coolant flows upward in the tube, around and between the fuel rods. Surrounding this central tube would be several layers of thermal insulation, with gas spaces between for leak-detection monitoring. An outer aluminum tube contains each fuel-pipe assembly.

The thermal insulation layers contain heat generated by fission in the fuel rods, keep it within the flowing sodium coolant and out of the heavy-water moderator outside the pipes.

In the monitoring spaces between the fuel tube and thermal isolation an inert gas—possibly helium—will be circulated. Monitoring these gas circuits will permit detection of any leakage between coolant and moderator.

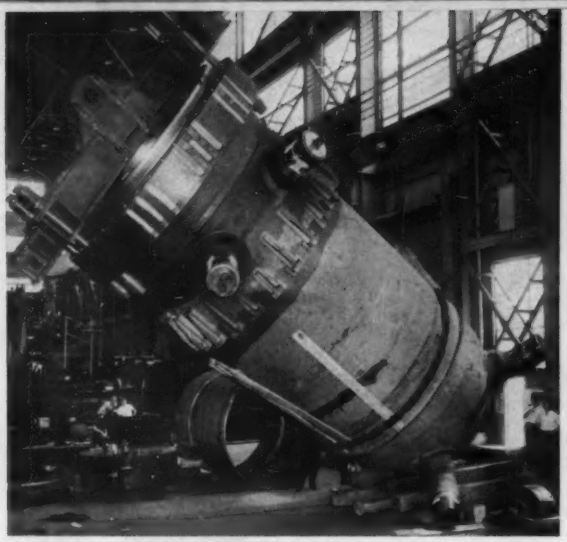
Sodium loop. A pump, at far right in the diagram, supplies liquid sodium to lower header which connects to central tubes in fuel pipes through "pigtails." Sodium flows up through tubes, in contact with fuel rods, and into upper header. It then passes through a heat exchanger and gives up its heat to a secondary liquid-metal loop, part of which is indicated at upper right. A heat exchanger in this secondary loop would generate steam.

Temperatures in the molten-sodium loops can be high without requiring pressure greater than needed to maintain flow. Hence thin-wall piping may be used. With high coolant loop temperatures, steam may be generated at conditions suitable for efficient turbine operation.

The deuterium is not pressurized either, so the reactor vessel need not be heavy. It would be surrounded by a graphite reflector to minimize escape of neutrons from the system. An additional 10-in. iron shield around the reflector would trap any neutrons that might pass through the graphite. High-density concrete would shield the reactor vessel and primary coolant loop to protect personnel against gamma rays.

Aside from its effectiveness, the heavy-water moderator offers practical advantages. Draining moderator shuts down the reactor; raising or lowering its level can be used for regulation. Boiling of the moderator provides an inherent safety mechanism.

Projected operating date for this proposed 10,000-kw plant is 1962. It promises to bolster capacity in the power-tight Greater Anchorage area, where fuel costs are extremely high.



SHELL weighs 150 tons, is 31 ft high by 9 ft inner diameter

HEAD STUDS, 6 ft long by 6 in. dia, weigh 700 lb with nuts

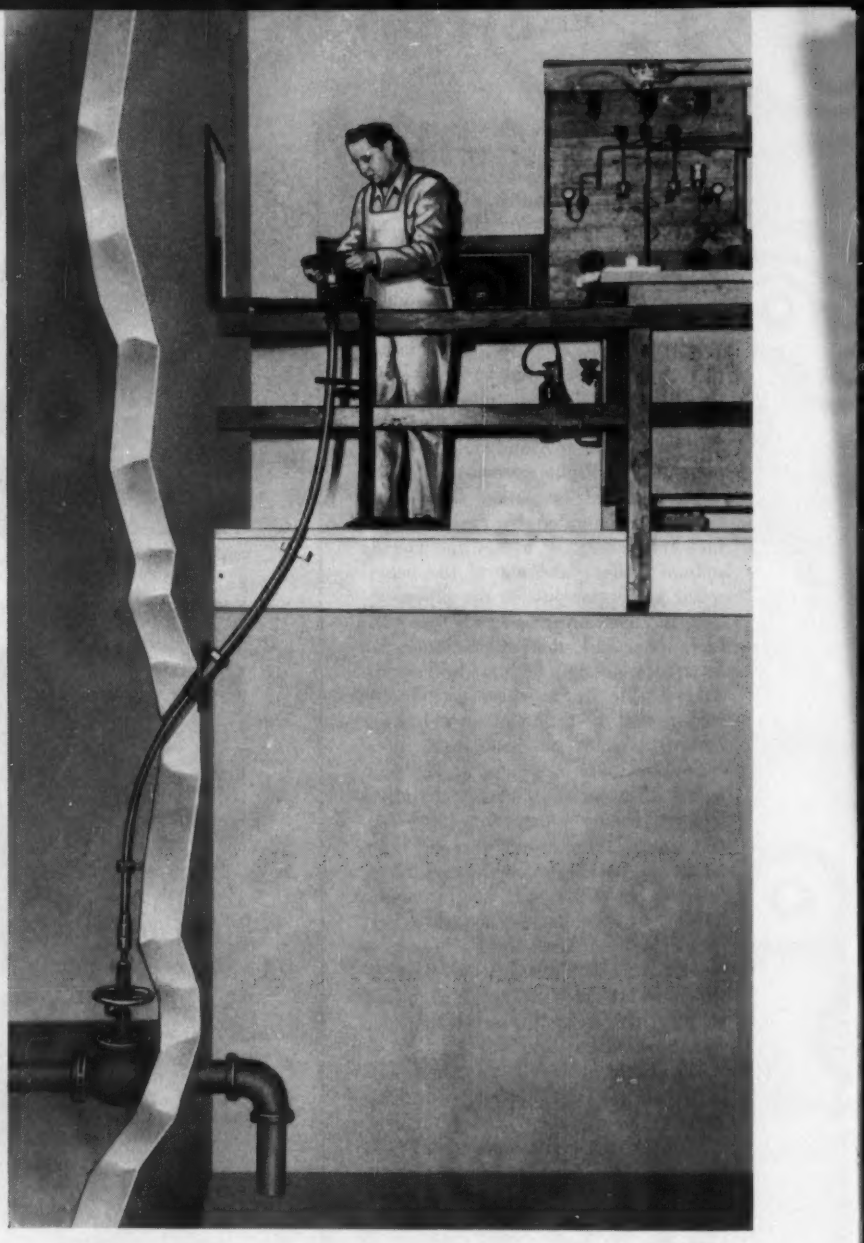
Giant reactor vessel ready for Shippingport plant

► WORLD'S HEAVIEST PIECE of nuclear-power equipment has been completed at the Chattanooga plant of Combustion Engineering, Inc. It's a 235-ton reactor vessel built for the first U.S. full-scale nuclear station at Shippingport, Pa.

Scheduled to go into operation next year with a net output of 60,000 kw initially, the Shippingport plant has been designed by Westinghouse under AEC contract. It will be operated by Duquesne Light Company.

Two years in the making, the reactor vessel is unique in size, weight, safety factors and close tolerances. The steel walls are 8½ in. thick, the shell is 31 ft high with 9 ft inside diameter. The removable top head, weighing 85 tons, is held by 42 studs, each 6 ft long and 6 in. dia.

Established formulas for stresses and thicknesses could not be used for plate and forgings of this size and new criteria had to be developed. The vessel was built by assembling sections of the heaviest (*Continued on page* 212)



ARTIST'S drawing shows easy control possible though valve is below floor, other side of wall

Remote control for manual valves

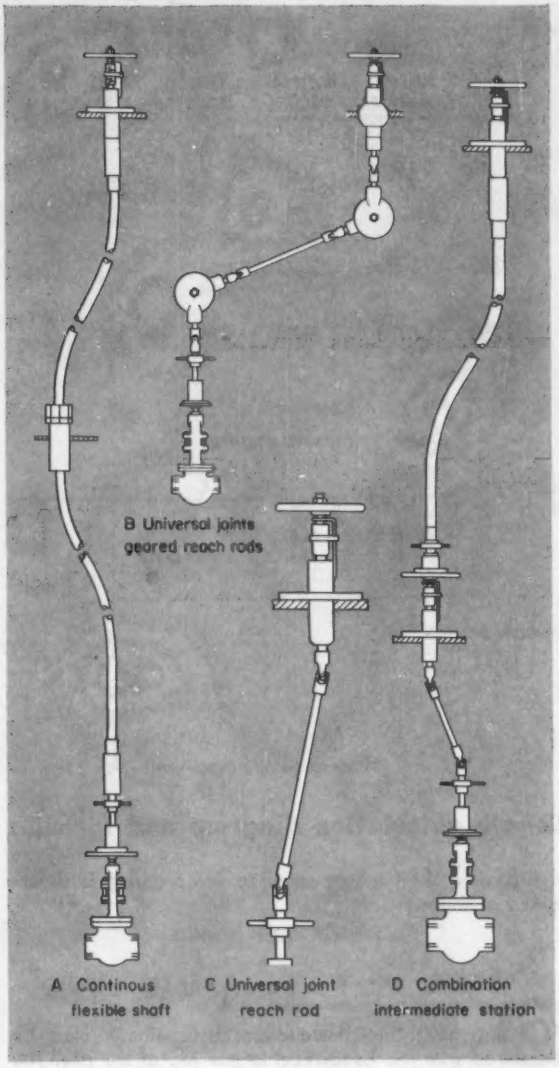
Use of flexible shafting, standardized valve-operating gear for reach rods, geared joints, gives quick centralized control of hard-to-get-at valves and eliminates hazardous climbing

By C HOTCHKISS JR, *Application Engineer, Stow Mfg Co*

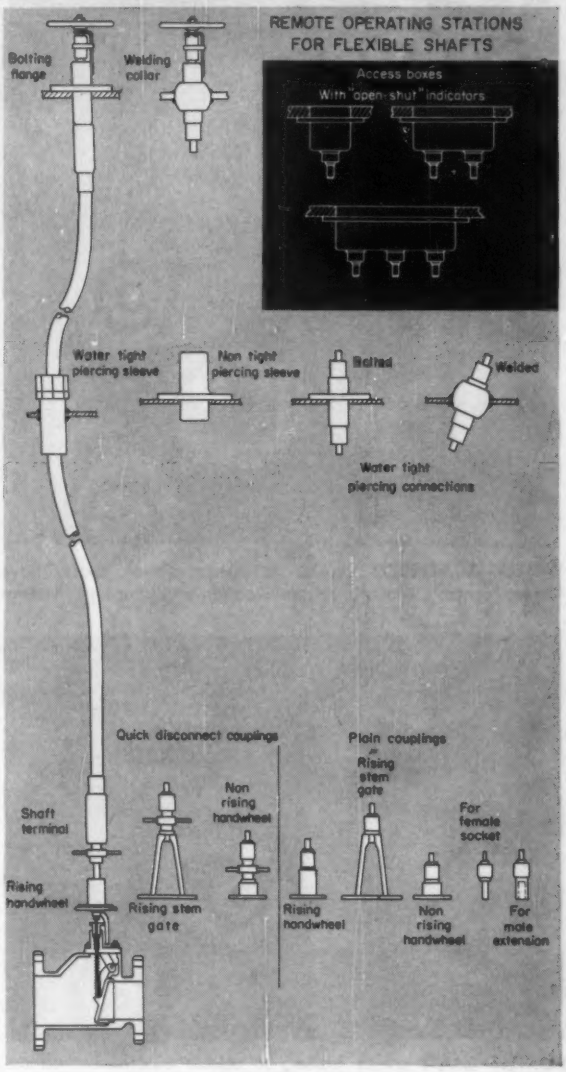
► MANUAL VALVE remote control has been used aboard ships of the world's navies and merchant fleets for a good many years. Its use was dictated by space limitations and emergency control conditions not normally faced by the stationary engineer.

However, such systems are being installed in industrial power plants in increasing numbers. In addition to the seagoing reasons, the systems are popular because they eliminate a lot of hazardous climbing, permit relatively

Typical station arrangements


B Universal joints geared reach rods
A Continous flexible shaft
C Universal joint reach rod
D Combination intermediate station

Valve couplings, access boxes



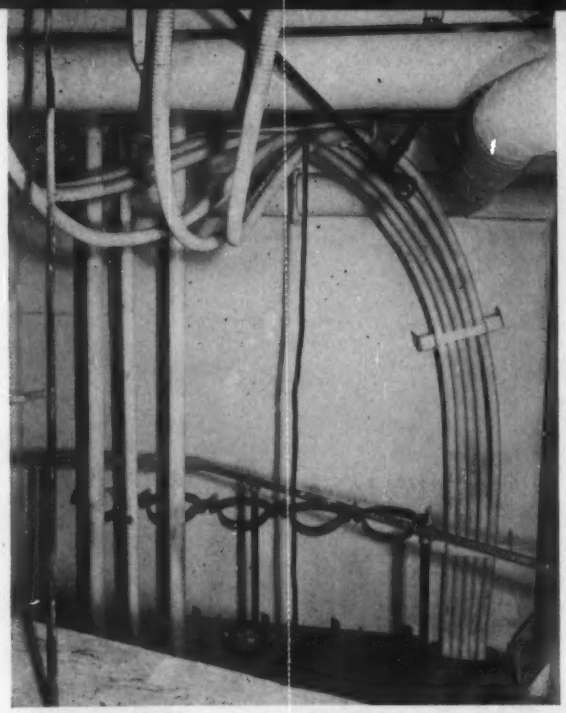
saves time, space — promotes safety

inexpensive central control of a number of widely scattered valves. And, it's no longer necessary for a plant engineer to have to design his own rig to get a manual remote control setup.

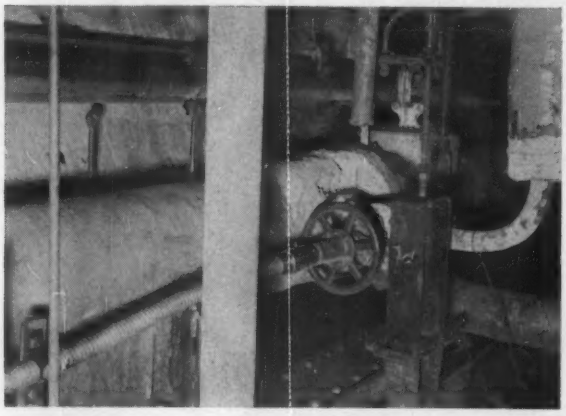
Typical installations of commercially available equipment are shown above, left. *A* shows a flexible shaft that can be used up to 100 ft in length and can go around a number of bends. *B* is an installation having geared joints that operate in any angle through 360 deg. Where bends are too sharp for flexible shafting, these are used in combination with reach rods or flexible shafts. *C* is a reach rod and universal joint often used for a short run where there's just a slight offset. *D* shows a combination reach rod and flexible shaft. Here a separate handwheel is used between the flexible shaft and reach rod along with a quick-disconnect coupling. If desired, an operator can open or close the valve at this point by disconnecting the flexible shaft and turning the handwheel.

The flexible shafting consists of a flexible core covered with a metal casing and having terminals at each end for connection to valves or couplings. The core is made up of a number of layers of wire, each layer wound in the opposite direction. The casing is interlocked asbestos-packed type, supplied by most manufacturers in either galvanized steel or phosphor bronze.

Somewhat more expensive, material-wise, than reach rods, flexible shafting is easier to install where the control makes several bends. No bearing blocks



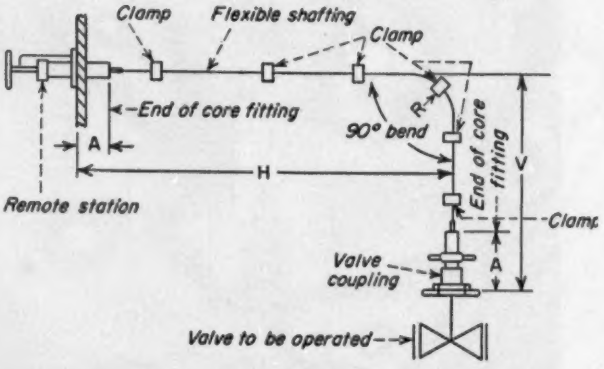
WIDELY SCATTERED valves, in hard-to-get-at spots, have remote controls brought to plainly marked, floor-level station



FLEXIBLE SHAFT shown leading to almost inaccessible atmospheric exhaust valve. Remote station gives quick control

Table 1 — Sizes and capacities

Size	Capacity (lb in.)		For use on	
	Minimum breakdown	Maximum operating	Flex. shaft	Rigid rod
40	1500	500	½	—
			¾	½ & ⅝
160	5000	2000	1	—
			1¼	¾ & 1
250	8750	3500	1⅜	1¼ & 1½



Length calculation diagram and formula

The flexible shaft length required for ordering is determined as follows:

Calculated length in inches

$$L = H - (A + R) + \frac{\pi R}{2} + V - (A' + R)$$

For rising handwheel installations dimension V must be measured with the handwheel at the top of the rise. The valve couplings are designed to telescope for closing.

are necessary, it's just clamped in place. With the casing covering the core, there are no exposed revolving parts and maintenance is easy and inexpensive.

First step in laying out a system is to select the correct component parts. Diagrams p 87, furnished by the manufacturer of standard remote operating stations, connections and sleeves, valves and couplings, simplify the job. Remote terminals are supplied for either welding or bolting. Indicators show open and closed position, important where an error in valving could be disastrous.

Single, double or triple flush-type access boxes with open and close indicators can be used with flanges for bolting to steel or wooden floors. Intermediate sleeves or connections are used where shafting passes through a floor. If the connection must be watertight, a piercing sleeve fits over the shafting and is welded into place. If leakage of a gas or liquid must be prevented, piercing connections are used. Unlike piercing sleeves, these require flexible shafts to be connected to each side and are used with either a welding collar or bolting flange.

Shaft-terminal couplings for connection to standard-type valves are attached by U-bolts to the handwheel spokes. The three standard couplings fit rising stem gate, rising and non-rising handwheel valves. With rising handwheel valves, a coupling with a square slip joint must be used to take care of the change in length when the handwheel raises or lowers. These couplings can also be used with quick-disconnect fittings.

Second step in layout is to determine the size and needed capacity of the unit. Table 1 shows the three sizes and capacities currently available for a standard installation. Shaft size must then be selected. Table 2 shows a typical chart supplied by any manufacturer. To use the table, length of the flexible shaft must be estimated. Knowing valve handwheel size and approximate length of shaft, the shaft size is easily picked out. Note that handwheel's diameter on the remote station is also shown. This

Table 2—Flexible-shaft selection chart for remote valve-control systems

Shafts selected from table will operate valves with normal effort at the remote station handwheel.
d = dia of flexible shaft. D = dia of remote station handwheel.

Valve handwheel dia; in.	Output torque (ft lb)	Length of remote control system ft*															
		5		6-10		11-15		16-20		21-25		26-30		31-40		41-50	
		d	D	d	D	d	D	d	D	d	D	d	D	d	D	d	D
3	10	½	5	½	5	½	5	½	5	½	5	¾	7	¾	7	¾	7
4	13	½	5	½	5	½	5	½	5	¾	7	¾	7	¾	7	¾	7
5	17	½	5	½	5	¾	7	¾	7	¾	7	¾	7	¾	8	¾	8
6	20	¾	7	¾	7	¾	7	¾	7	¾	8	¾	8	1	9	1	10
7	26	¾	8	¾	8	¾	8	¾	8	¾	8	1	10	1	10	1	12
8	30	¾	8	¾	8	1	9	1	10	1	10	1	10	1	12	1	12
9	34	¾	8	1	10	1	10	1	10	1	10	1	10	1	12	1	12
10	40	1	10	1	10	1	12	1	12	1	12	1	12	1	12	1¼	14
11	46	1	12	1	12	1	12	1	12	1	12	1	12	1¼	14	1¼	16
12	50	1	12	1	12	1	12	1	12	1	12	1	12	1¼	16	1¼	18
14	70	1¼	16	1¼	16	1¼	16	1¼	18	1¼	18	1¼	18	1¼	21	1⅝	24
16	80	1¼	18	1¼	18	1¼	18	1¼	18	1¼	18	1¼	21	1⅝	24	1⅝	27
18	90	1¼	18	1¼	18	1¼	18	1¼	21	1¼	21	1⅝	21	1⅝	24	1⅝	27
21	122	1¼	21	1¼	21	1¼	21	1¼	21	1⅝	27	1⅝	27	1⅝	27	1⅝	27
24	140	1⅝	27	1⅝	27	1⅝	27	1⅝	27	1⅝	27	1⅝	27				
27	158	1⅝	27	1⅝	27	1⅝	27	1⅝	27	1⅝	27						

All flexible-shafting remote control systems below the heavy line have undersized handwheels, therefore two-man operation is required.

*Where a system consists of more than one flexible shaft, use total length for size selection.

diameter is larger than the station handwheel's since extra leverage is needed to overcome friction losses in the flexible shaft.

Where a flexible shaft is used in combination with solid rods, system's total length must be used in selecting the flexible shaft size. Shown under Table 1 is a diagramatic example, together with the formula used to calculate the exact length of shaft needed between valve and control station handwheel.

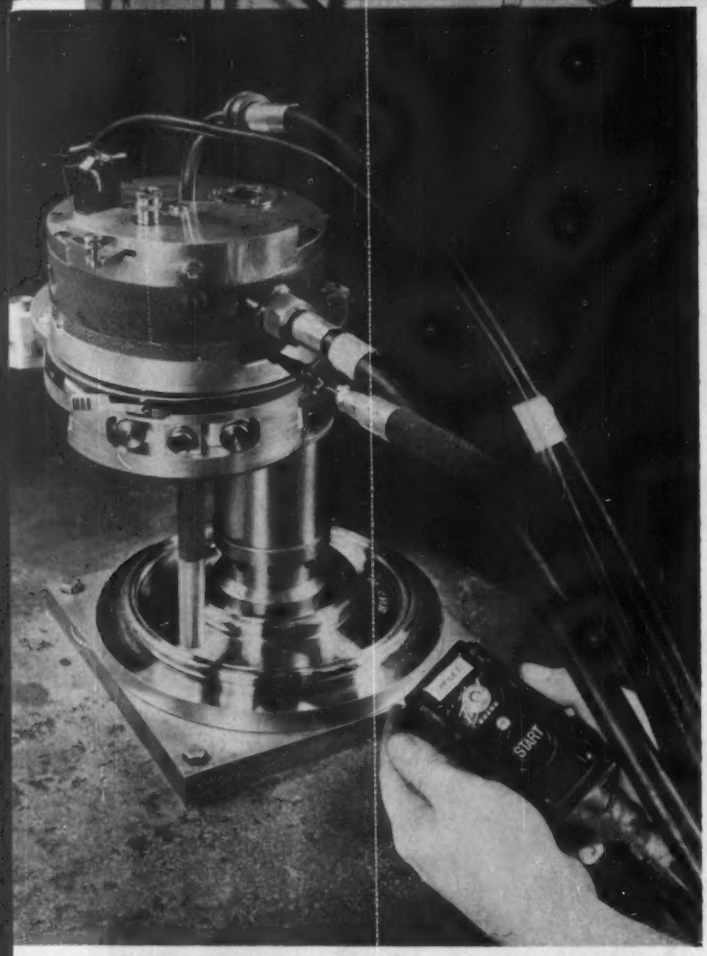
Geared joints are popular because they simplify design and installation by allowing workmen to quickly set them for any angle and then tighten the nuts to lock them in place. As stated, they're generally used where bends are too sharp for flexible shafting. They operate through any angle up through 360 deg. Attractive feature is that they can have flexible shafts or solid rods on both ends or flexible on one end and solid rod on the other. However, universal joints should be used between the geared joint and reach rod or coupling to take care of misalignment.

An example of emergency remote control is shown in top photo p 88. Flexible shafting to this atmospheric exhaust valve, normally accessible only by hazardous climbing, brought necessary quick-opening control down to an operating platform. Installation was merely a matter of placing the shafting in the approximate position, attaching each end and clamping it along its length.

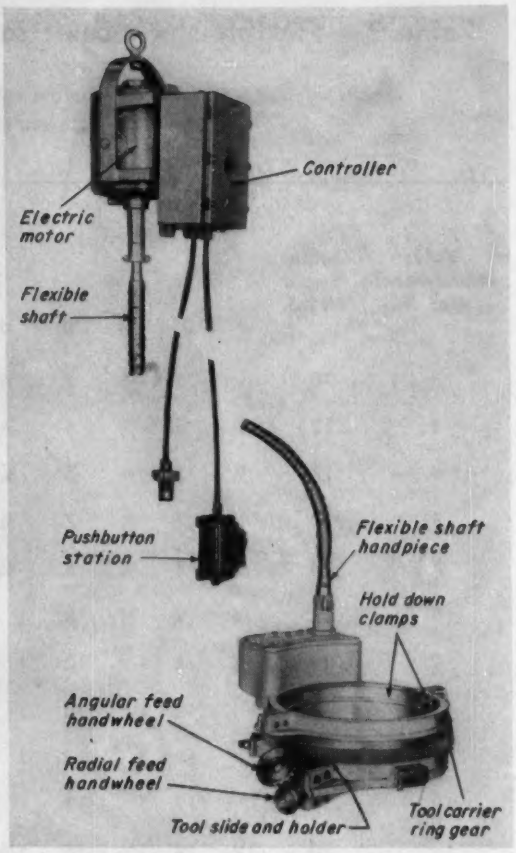
Another installation pointing up the efficiency of manual remote control is shown in the lower photo, p 88. Here, five widely-separated valves in a power plant are controlled from a central station.

An important feature of manual remote control is the ability to throttle flow to almost any desired degree. In many cases, such control, through reach rods or flexible shafts, can considerably reduce purchase and maintenance costs by eliminating need for electric, pneumatic or hydraulic control equipment.

Where required, flexible shafting can be had in special materials to meet nonmagnetic or other specific needs.



1—Welding machine helps make tight joints



2—Seal-weld cutter speeds the job

Stringent need for absolute cleanliness and tightness of reactor primary systems demands new approach in plant maintenance practice. Here are some new tools developed for making welds

Maintaining nuclear

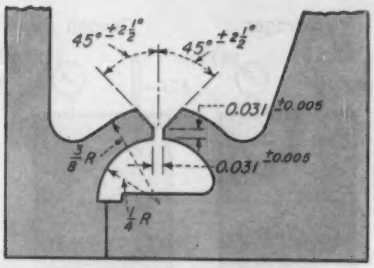
► THE PRIMARY SYSTEM of a reactor power plant consists almost entirely of stainless steel components with all the joints welded. On those components of a primary system that must be removed for servicing and repair a seal weld, rather than a strength weld, prevents leakage. When a component, like a canned motor, must be removed a seal-weld cutting machine may be used. Seal welds may be cut open by hand tools, but these give rough surfaces to the severed parts. Fig. 2 shows a typical cutting machine; this machine prepares the component and its mating volute or base for the replacement weld at the time it cuts the original weld.

To assure making an acceptable seal weld on the thin omega sections, Fig. 3, where hand welding may easily cause a burn-through, an automatic welding machine should be used, Fig. 1. By welding two or three test pieces in the machine before making the production run we meet very little difficulty, even on complicated welds.

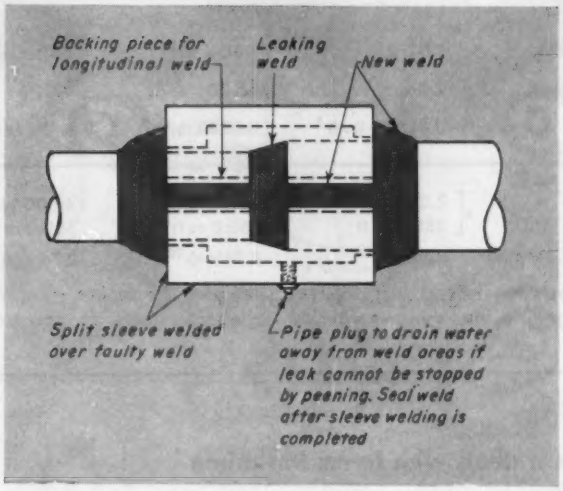
Practical welds. We find it prudent to set up practice welds whether welding by machine or hand. We feel it important to test weld on pieces that later can be sectioned and examined for proper penetration and freedom from inclusions or cracks. Hand welding should, of course, be done only by experienced and qualified welders after completing successful test pieces.

One common trouble that develops in all-welded hydraulic systems is minute leaks in small welds. Experience has shown that with strict adherence to welding specifications and adequate inspection, the number of leaks will be of the order of 0.2% of the total welds that cannot be radiographed. In present practice we radiograph all butt welds (generally used in pipe over 1¼-in. dia.) and no leaks should be found if the weld passes a radiograph inspection.

Slag inclusions in welds, and pinholes not revealed by dye checking, usually cause the leaks in small welds. In present practice we grind and dye check the root or initial pass as well



3—Seal-weld joint section


Backing piece for longitudinal weld
Leaking weld
New weld
Split sleeve welded over faulty weld
Pipe plug to drain water away from weld areas if leak cannot be stopped by peening. Seal weld after sleeve welding is completed

4—Sleeve weld for emergency repairing

By R E CREWS and J M YADON, *Westinghouse Electric Corporation*

reactor plants: 3

as the final pass; this is almost 100% effective in disclosing cracks. Pinhole leaks usually show up on the initial hydrostatic tests, but slag inclusions usually do not cause a leak until after extended operation. In a pressurized-water system the slag gradually dissolves in the high-temperature water and a leak develops.

In general, we find it impractical to attempt to repair a faulty weld unless the leak is isolated by closing valves or by freezing the liquids within the lines to stop flow and draining the line feeding the leak. To minimize shutdown time we sometimes temporarily repair small lines by making a special fitting to enclose the faulty weld and eliminate draining or freezing of lines. Fig. 4 shows a typical method. To eliminate water spraying or leaking into the weld area while doing the job, it is often possible to peen the leaking area after the system has been depressurized. Rarely, if ever, should a repair be attempted prior to cooling the system to about 200 F or below. This type of repair is usually temporary since the weld will not take an unlimited number of thermal shocks without developing cracks.

Other tricks of the trade will develop as we gain experience. With the prime consideration of protection against radiation exposure, progress may be slow. Future advances in techniques, tools and materials will no doubt greatly assist in the important tasks of nuclear-plant maintenance.

Special tools used in nuclear maintenance and repair programs include the following:

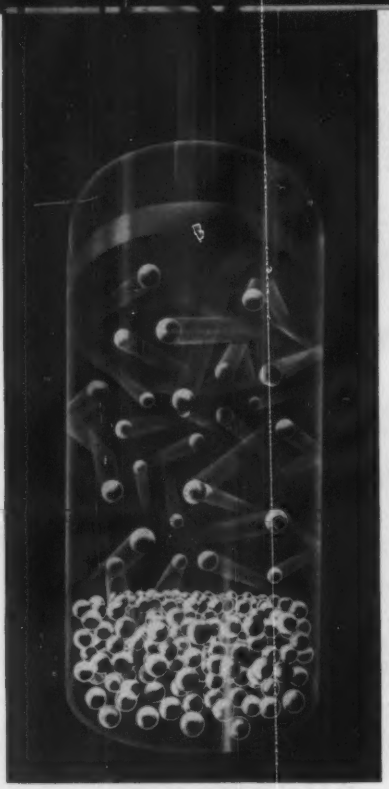
Mechanical
- Seal-weld cutting machine
- Automatic welding machine
- Torque wrenches
- Bolt heaters
- Weld-inspection material:
  - a. Dye checking apparatus
  - b. Gamma source and radiographic material
- Leak-testing equipment
- Special valve tools
- Air-driven hand grinders with large assortment of wheels and burrs
- Stress-relieving equipment
- Industrial stethoscopes
- Boroscopes

Electrical and nuclear
- Industrial analyzer
- Vacuum-tube voltmeters
- Oscilloscopes
- Multichannel "Sanborn" recorder
- "Brush" recorders
- Neutron source
- Gamma source
- Multiscaler

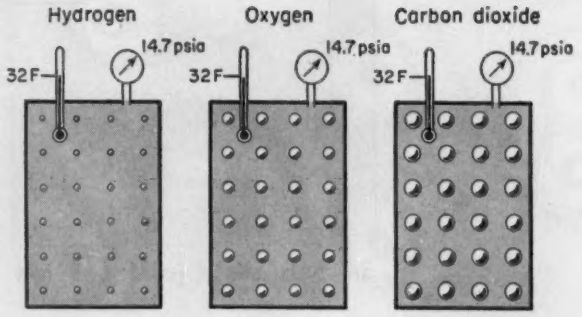
Instrumentation
- Manometers
- Deadweight tester
- Temperature device equipment:
  - a. Oil bath
  - b. Oven
- Test standard thermometers
- Test standard pressure gages

Conclusion. Until more experience has been accumulated, precise planning and coordination between designers, contractors and operators must be achieved as a prerequisite to a successful nuclear power plant. To prevent unscheduled shutdowns, the service and maintenance provisions must be thoroughly integrated into the design, construction and operating criteria of the plant and each component. Maintenance personnel must be carefully trained and have a working knowledge of the plant characteristics. The service groups, including industrial hygiene, procurement and stores, must be prepared to efficiently perform their assigned tasks.

For the next several years, nuclear-plant service and maintenance will cost considerably more than that experienced by conventional steam power plants. With new materials and methods that will develop as the field expands, we expect to simplify the service and maintenance problems of the nuclear power plant.



THERMO REFRESHER NO. 4



	Hydrogen	Oxygen	Carbon dioxide
Gas volume	1 cu ft	1 cu ft	1 cu ft
No. of molecules	7.62×10^{23}	7.62×10^{23}	7.62×10^{23}
Molecular weight	2.016	32.00	44.00
Total weight	0.00559 lb/ft^3	0.0889 lb/ft^3	0.122 lb/ft^3
Mole of gas	2.016 lb 359.2 cu ft	32.00 lb 359.2 cu ft	44.00 lb 359.2 cu ft
No. molecules per mole	2.74×10^{26}	2.74×10^{26}	2.74×10^{26}

1 Avogadro's law tells us that different gases with like volume, temperature and pressure have the same number of molecules, which fix gas total weight

Ability to measure the quantities it deals with forms the prime basis of any science. After finishing with the perfect gas equation in this part, we start looking at the different ways of measuring energy, since . . .

Pounds of water and temperature

► LAST MONTH we learned how to use the perfect gas equation: $PV = RT$ where each gas has its own constant R. This equation covers a more general relationship among all gases than we might suspect on first introduction. To understand this we must remember that the atoms and molecules of a gas have a definite mass or weight per particle. For instance, a hydrogen atom has a mass of 1.008 units and an oxygen atom 16.000 units. But, in the usual forms of hydrogen and oxygen gases, we find that the atoms pair off to form molecules so that a hydrogen molecule weighs 2.016 units and an oxygen molecule 32.000 units.

Avogadro's law. Back in 1811 an Italian, Avogadro, proposed a theory that later proved correct: *Equal volumes of perfect gases held under exactly the same conditions of temperature and pressure each have equal numbers of molecules.* Many experiments have since shown that there are 7.62 $\times 10^{23}$ molecules in a cubic foot of *any* perfect gas when it exerts a pressure of one atmosphere (14.696 psia or 2116 psf) and has a temperature of 32 F (492°R), Fig. 1.

For most engineering work, however, we don't need to know the number of molecules. But Avogadro's law tells us that if a given volume of hydrogen weighs 2.016 lb then an equal volume of oxygen at the same pressure and temperature will weigh 32.00 lb. The same as the ratio of their molecular weights, since there are an equal number of molecules in the two volumes.

With this basic idea let's look again at the perfect gas equation and write separate equations for hydrogen and oxygen:

$$PV_H = R_H T$$
$$PV_O = R_O T$$

Assuming we have both gases under the same P and T we see immediately that the gas constants must have the same ratio as the specific volumes. Dividing the hydrogen equation by the oxygen we get:

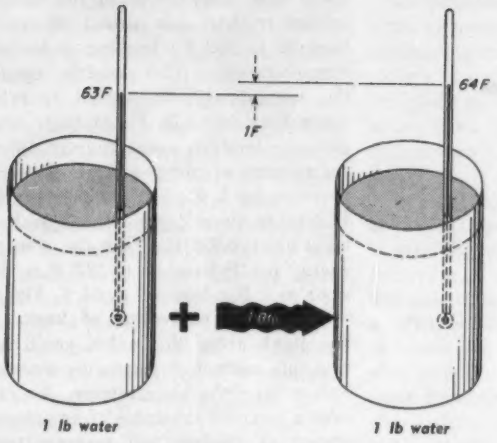
$$\frac{V_H}{V_O} = \frac{R_H}{R_O}$$

But the gas density $D = 1/V$, then:

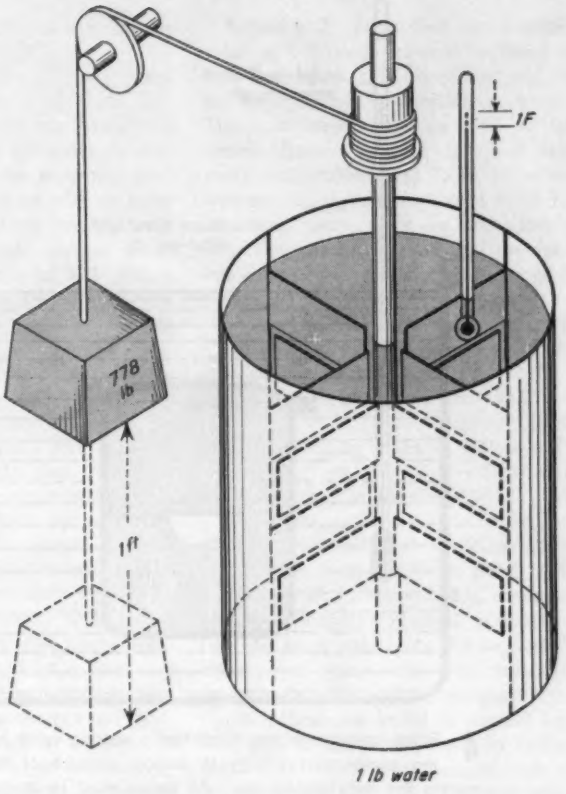
$$\frac{D_O}{D_H} = \frac{R_H}{R_O}$$

Since densities of gases have the same ratio as their molecular weights:

$$\frac{32.000}{2.016} = \frac{R_H}{R_O}$$



2 British thermal unit, Btu, is the amount of energy that warms one lb of water at 63-F temperature by 1 F to 64 F



3 Joule's experiment showed that using 778 ft-lb of work to churn one lb of water warmed it by 1 F, or by 1 Btu

By B G A SKROTZKI, *Associate Editor*

changes measure energy quantity

$$32.000R_O = 2.016R_H$$
$$32.000 \times 48.29 = 2.016 \times 766.5 = 1545$$

This tells us that multiplying the gas constant of any perfect gas by its molecular weight gives us a *universal gas constant* of 1545. If we call this univeral gas constant R_u and the molecular weight M, then:

$$M_H R_H = M_O R_O = MR = R_u = 1545$$

While this holds for theoretically perfect gases and many actual gases, some gases deviate slightly from this value.

Now let's see how we can use R_u. For any perfect gas: $PV = RT$

Multiply both sides by M:

$$PMV = MRT$$
$$PV_M = R_u T$$

We could call this the general perfect gas equation. The specific volume of any gas multiplied by its molecular weight M is written as V_M which has the special name of *mole volume*. By rearranging the general equation we can solve for V_M to get:

$$V_M = \frac{R_u T}{P}$$

Now, let's study this carefully. Since R_u is a constant for all perfect gases, and if we set a standard P and T for all gases, then the mole volume is a constant for all gases. Choosing P as 2116 psf and T as 492°R we then find that:

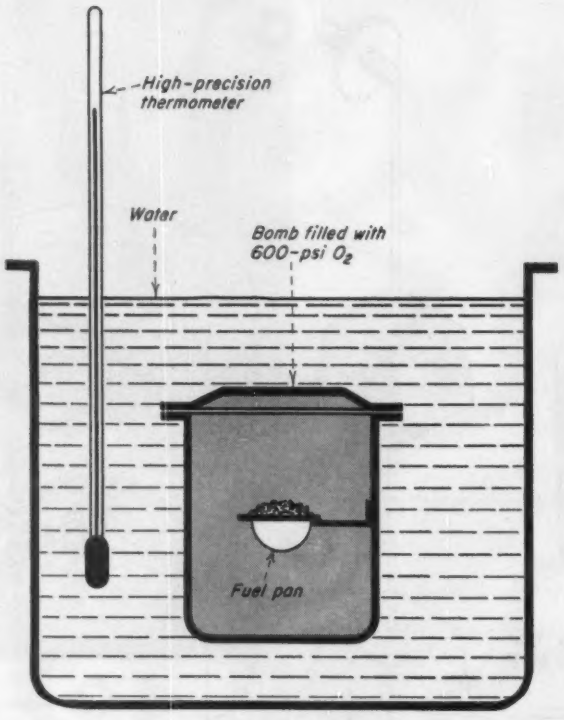
$$V_M = \frac{1545 \times 492}{2116} = 359.2 \text{ cu ft}$$

This means that the mole volume of *any* perfect gas is 359.2 cu ft at standard P and T. Note that V_M is not a *specific* volume but the *total* volume of M lb of a gas. In fact we call this a *mole* of gas. A mole of gas always weighs M lb, has a gas constant of 1545, and a volume of 359.2 cu ft at 2116 psf and 492°R. This mole idea becomes very useful when dealing with gas mixtures, more of this later in the series. Let's try out this general perfect gas equation and see what we can do with it.

Example 1: A gas bottle holds 3 cu ft of CO_2 under a pressure of 300 psia at a temperature of 140 F. How many pounds of CO_2 are in the bottle?

First let's find the molecular weight of CO_2. Carbon, C, has an atomic weight of 12 and oxygen, O, an atomic weight of 16. Then for CO_2 the molecular weight $= 12 + 2 \times 16 = 44$.

Substituting in the general perfect gas equation and remembering that P must be in psf and T in °R we get:



4 Bomb calorimeter measures fuel's heating value by absorbing combustion energy in known amount of water and noting the temperature rise. All losses must be accounted for

$PV_M = R_u T$
$PMV = R_u T$
$(300 \times 144)\ 44V = 1545\ (140+460)$
$V = 0.4877$ cu ft per lb

Since there are 3 cu ft in the bottle, then the weight of CO_2 is:

Weight $= 3/0.4877 = 6.15$ lb

MEASURING ENERGY

In Part 1, we discussed the mechanical forms of energy and how they were measured in ft-lb units. We learned that there were parallel forms in the internal energy of substances that we loosely call heat. Such internal energy is the mechanical energy of the molecules and atoms making up the substance. Since it's impossible to see these particles and there are so many of them, it becomes very difficult to measure internal energy in ft-lb dimensions; we have to use other methods.

Internal energy. Water, being plentiful and fairly uniform in its behavior and composition, makes a convenient substance with which to measure internal energy. We can increase the internal energy of the water in a can by heating it with a flame, standing it in the sunshine, or by stirring it violently. You will be able to think of many more ways of raising the internal energy of the water so that its temperature will rise.

Table 1 — Molecular weights of gases

Gas	Molecular weight
Dry air	28.96
Carbon monoxide, CO	28.00
Hydrogen, H_2	2.016
Nitrogen, N_2	28.02
Oxygen, O_2	32.00
Helium, He	4.00
Carbon dioxide, CO_2	44.00
Water vapor, H_2O	18.01

To measure internal energy absorbed by water we must know two things: (1) the mass or weight of the water (2) the change in temperature. So let's take one pound of distilled water in a can at a temperature of 63 F, then carefully heat it over a flame until its temperature rises to 64 F. The amount of internal energy gained by the water during this heating is the basic energy unit called one *British thermal unit, Btu.* The same amount of energy would raise the temperature of two pounds of water by only ½ F, or raise the temperature of ½ lb of water by 2 F. When we use this unit we in effect are saying that X Btu is the amount of energy that will heat X lb of water by 1 F.

An equivalent definition of a Btu states that it's 1/180th of the energy needed to heat one pound of water from 32 to 212 F (freezing to boiling temperatures). This exactly equals the amount of heat needed to raise water from 63 to 64 F. At other temperature levels it takes slightly different amounts of energy to raise the temperature by 1 F. For instance, at 41 F it takes about 1.005 Btu, at 86 F it takes about 0.998 Btu. But the average energy per F from 32 to 212 F is the same as 1 Btu from 63 to 64 F, Fig. 2.

Mechanical equivalent of heat. If you think about this a bit, you'll see that this method of measuring internal energy is simple, but arbitrary. We can take a common substance of an amount chosen at random and measure temperature rise on a scale of somewhat arbitrary units. How do we square this with the more scientific mechanical energy unit—ft-lb?

This was done back in 1843 by an experiment performed by an amateur scientist, James Joule (he was a brewer). The experiment has since been performed many different ways by others and the relation between ft-lb and Btu has been considerably refined. Fig. 3 shows schematically the elements of his experimental equipment. The tank holds a known amount of water. A set of fixed vanes in the tank are arranged so paddles carried on the vertical rotating shaft can pass between them.

The shaft is rotated by a cord wrapped around the pulley at the upper end. The cord is pulled by known weights falling through a measured distance. You can see that the water will be churned by the paddles every time the weights fall. This heats the water by frictional effect and raises the water temperature, which in turn is measured by the thermometer. From the weight of water and temperature rise, the Btus of internal energy gained can be figured and compared with the ft-lb of mechanical work done by the falling weights.

Many experiments have shown that 1 Btu = 778.26 ft-lb. We'll use 778 ft-lb per Btu as being close enough for our work. In honor of Joule, the figure 778 is given the symbol J. The mechanical equivalent of heat can be checked several different ways, also by theoretical calculations. Because thermodynamics deals with the changes of energy between thermal and mechani-

cal forms we will frequently use J in our figuring.

Electrical equivalent of heat. Today we make much use of electrical energy and we obviously have to know how the kwhr (kilowatt-hour) unit of energy is related to the Btu. The form of experiment suggests itself. Simply immerse an electric heater in a known amount of water. Measure the kwhr of electric energy expended by the heater while it raises the temperature of the water. This type of investigation shows that 1 kwhr = 3,412.75 Btu, we round this out to 3413 Btu/kwhr.

Energy. From what we have talked about so far, we see that energy may be measured in many different units. We haven't met all of them yet. In addition to the English system of units that we use, there is the centimeter-gram-second system used by scientists. We're not going to talk about the latter in this series.

Ordinarily we use the energy units that are most convenient to the problem we are handling. There is nothing, however, to bar us from solving a mechanical problem in terms of kwhr, or an electrical problem in terms of ft-lb. We just have to keep in mind the ratio of the different energy units:

1 Btu = 778 ft-lb = 0.000293 kwhr
0.00128 Btu = 1 ft-lb = 0.000000377 kwhr
3413 Btu = 2,656,000 ft-lb = 1 kwhr

You can use this little table or simply remember that:

1 Btu = 778 ft-lb and
1 kwhr = 3413 Btu

The last two equalities will usually be enough to solve most problems quickly.

Calorimetery. In the everyday operation of power plants we wish to know the heating value of fuels burned in the plant's furnaces. These heating values are given as Btu per lb of fuel. Fig. 4 shows basic elements of a bomb-type calorimeter used to find the heating value.

A very small sample of the fuel to be tested, powdered coal for example, is carefully weighed and placed in the fuel pan of the bomb. The bomb is assembled and tightly shut. Through a valve, not shown, compressed oxygen is forced into the bomb up to a pressure of 600 psig. The oxygen is about three times that needed to insure completely burning the fuel.

The bomb is immersed in a known amount of water. The fuel starts burning after being ignited by a fuse wire in contact with it. An electric current heats the fuse wire, not shown in Fig. 4.

All the heat developed by the burning fuel passes into the water surrounding the bomb. The fuel heat raises the water temperature which we measure by the high-accuracy thermometer which can be read to 1/100th of a degree F.

Example 2. Let's find the heating value of a bituminous coal in Btu per lb. We placed 0.004 lb of the coal in the fuel pan of the calorimeter bomb. The calorimeter contains 6.00 lb of water. Before igniting the fuel the water temperature was 72.55 F; after burning, the thermometer read 81.97 F. Assuming there were no heat losses from the calorimeter and that the fuel was completely burned, what is the coal heating value?

Basic principle of the calorimeter is:

Heat absorbed by water = heat developed by burning fuel

Water temperature rise = 81.97 − 72.55 = 9.42 F

Heat absorbed by water = 9.42 × 6.00 = 56.52 Btu

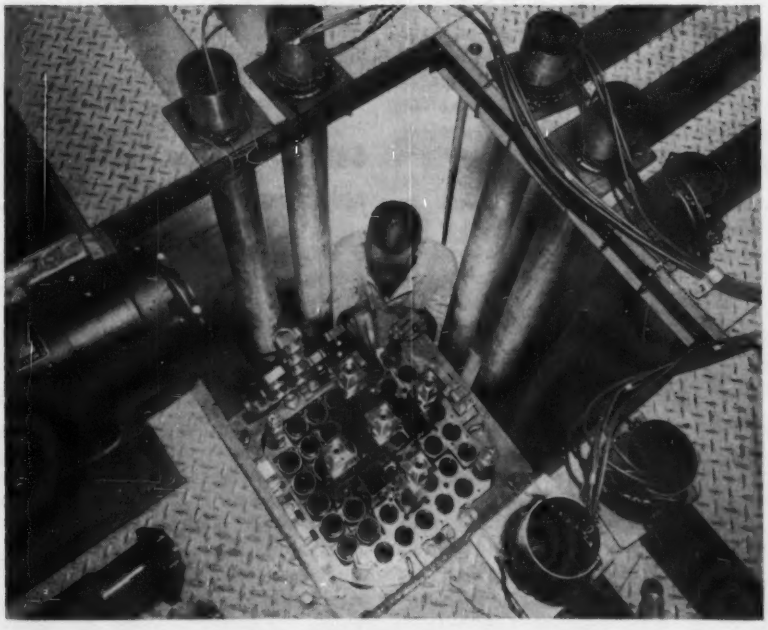
Heat developed by burning 0.004 lb fuel = 56.52 Btu

Heating value of coal = 56.52/0.004 = 14,130 Btu per lb coal

As you might suspect this example has been highly simplified to emphasize the basic principles. In an actual calorimeter, many corrections must be made to find the true temperature rise, the principal one being to correct for heat gain or loss of the water by radiation. The calorimeter usually has a stirrer to mix the water for even temperature distribution; it also has a water jacket to reduce radiation.

Next part will deal with gas specific heats and gas energy equation.

Army package power reactor core under test

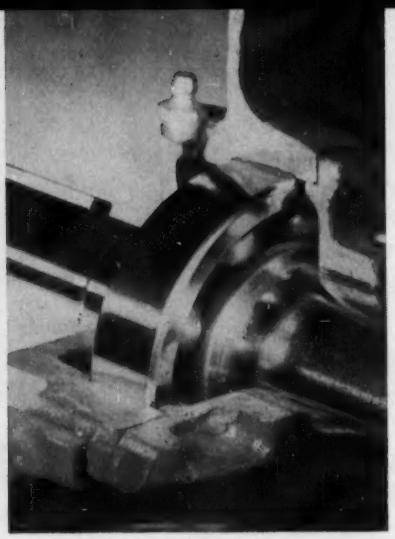


► REACTOR CORE for the 2000-kw plant being built by Alco Products, Inc is being put through its preliminary paces. Here we see it in the builder's new criticality facility, located on the banks of the Mohawk River in Schenectady, N. Y. Zero-power tests, run at about one watt of heat output, check the nuclear characteristics of the core.

The facility includes a 2-story reinforced-concrete reactor room, control room, counting room and administrative offices. The reactor room, 40x30 ft and 30 ft high, houses a 2500-gal unpressurized reactor water tank supplied by a 3500-gal storage tank in the basement. A quick-opening valve can drain the reactor tank quickly in an emergency to shut down the core.

Many types of cores can be zero-power tested in this facility. An average of about five specialists will be needed to run the tests. All possible efforts are made to reduce radiation hazards to a minimum.

By E R BOOSER
General Electric Company
Schenectady, New York



ACCESSIBILITY of grease fittings and adequate grease reservoir aid maintenance

Reduce motor bearing maintenance

Three rules for good electric motor lubrication:

1. **Use grease recommended for type of motor and operating conditions**
2. **Relubricate at periods selected for motor size, type, service**
3. **Make sure that you keep the grease clean**

The job grease does in modern motors

► TODAY'S ELECTRIC MOTORS are smaller, more efficient and have a longer life because of advances in design and materials. (See POWER's special report in June, 1955.) Manufacturers of ball-bearing greases have kept pace, and developed products that more than meet the demands imposed by higher speeds and heavier loads. Careful selection and use of the new greases will often allow increases of 50% or more in relubrication periods. With use of the best greases in many motors up to 5 hp, relubrication is no longer necessary for 5 or 10 years or more under most operating conditions.

Lubricating oil that coats the parts of a ball bearing is absolutely essential for satisfactory operation. Without a protective film on the heavily stressed contact areas between the balls and raceways, and in the zone of high-speed rubbing between the balls and separating cage, the excessive friction involved would result in rapid wear and almost immediate failure.

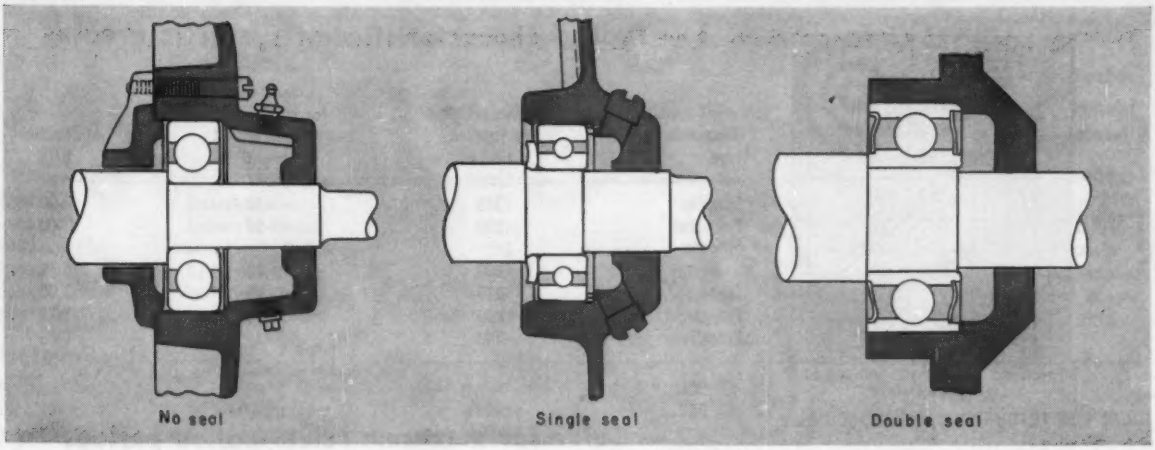
Primary functon of the grease in a motor is to supply this essential lubricating oil from the sponge-like reservoir of its gel structure. Although absolutely essential, the amount of lubrication is extremely small. Laboratory tests show that only 1/30th of a drop of oil is required to satisfactorily coat the balls, raceways and cage-separator surfaces of a ball bearing for a 5-hp motor. Months of satisfactory operation could be obtained in such a motor with as little as a single drop of oil under ideal conditions of cleanliness. A high order of chemical and physical stability is required in a grease for best results so that this small but life-preserving lubrication may be available for a period up to many years under ideal conditions.

In addition to providing the lubricant, greases are almost always required to prevent rust, protect bearings from dirt and minimize maintenance. Since so very little oil is required for lubrication, these secondary functions often will dictate the type of grease to be used.

Grease selection should also be integrated with the bearing and housing for the type of service to be met. For best results an open bearing in a conventional grease housing requires an entirely different grease than a double-sealed or double-shielded bearing, see sketches at top of facing page. Both types have applications for which they are best suited. With the most suitable greases in each case, however, open bearings in well-designed housings will not require relubrication for twice as long as for double-sealed bearings.

Select suitable motor-relubrication schedule

If left in service long enough, all greases will deteriorate because of bleeding, evaporation, oxidation, dirt and moisture so that they will no longer lubricate the bearings. This condition is usually reached when about half of the oil originally present in the grease has been lost. With rapid improvements being made in quality of greases, you'd do well to review your relubrication schedules with view to lengthening them and decreasing maintenance in many applications. Maximum relubrication periods recommended for long bearing life of electric motors are given



TYPICAL BEARING HOUSINGS generally used in conjunction with sealless, single-sealed and double-sealed ball bearings

through proper grease selection

in Table 2 on page 98. Suggested relubrication periods vary with the size of motor and with operating conditions, from a short period for large motors operating at high temperatures and in dirty applications up to quite extended periods for small motors operating under normal conditions. Improvements in grease life have been so pronounced that it is no longer necessary to relubricate many motors on intermittently used industrial equipment.

Ultimate life available in ball-bearing greases under controlled laboratory conditions is suggested in graph at top of page 98. Curves indicate the life test results obtained with the best present-day greases in both open and double-seal bearings. Double-sealed and double-shielded types are normally obtained with a grease charge from the bearing manufacturer.

Temperatures have an important influence on grease life. Usually grease life can be expected to increase by a factor of 1.5 when the temperature drops 10 C (18 F) at the bearing. Decreased bearing load and lower shaft speed will usually result in a somewhat increased grease life. The life indicated in graph for greases in size 306 ball bearings operating at 3600 rpm would have to be shortened for larger size bearings used in motors of 10 hp and larger, while the forecast could be increased slightly for smaller motors in the fractional-hp range.

Since relubrication is necessary in many types of heavy-duty motor service, the use of open bearings in housings such as those shown above is generally desirable. Such housings are equipped with a grease-gun fitting so grease can be added easily, and a relief plug is provided so older grease can be purged from the bearing and housing. Such an arrangement makes it possible to flush the bearing and clean it without disassembling the motor. And, in a great majority of cases, it is not necessary to stop the motor during relubrication.

More detailed relubrication recommendations are available from motor manufacturers and many grease suppliers for specific applications. Often laboratory analyses of greases from a representative sample of a large number of motors will give a good indication as to the life expectancy remaining for the grease in the motors. You'll find such information very valuable in setting up your relubrication schedules for minimum maintenance and maximum reliability of motor service.

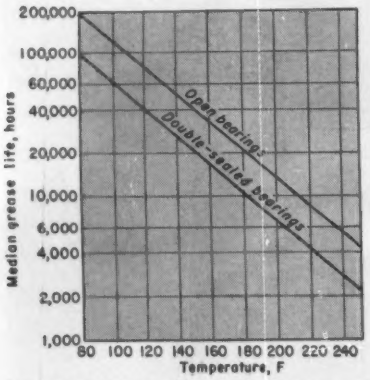
Choose the proper grease for best performance

Grease specifications for best performance under different conditions can be determined with aid of Table 4, on page 99. The *general purpose* grease, which has a Grade 2 consistency, has both mechanical stability and feeding properties that are satisfactory for many types of applications involving a large variety of bearing sizes. Such a grease is useful in medium-size motors in temperature range from –25 to +210 F. Of specifications listed, performance characteristics are most important. Although compatibility between different greases is not a serious problem, you should check whether they are compatible before using them interchangeably. In general, avoid mixing various soap types.

High-temperature operation, in the range above that possible with general-purpose greases, require a silicone-type grease such as shown in Table 4. These silicones are generally used at temperatures to about 300 or 325 F with suitable heat-stabilized ball bearings. Some special newer types of silicone greases thickened with aryl ureas may be useful for limited periods of operation up to about 400 or 450 F. Operation at these high temperatures should be attempted only with motors designed with suitable components and insulation.

Below –10 to –25 F, a diester grease of the type indicated in Table 4 should be used. Such greases should prove useful to about –65 F in a large variety of motor sizes using either open or double-sealed bearings and at temperatures to about 210 F. For extremely low temperatures, ranging down to about –110 F, some of the new silicone diester greases allow satisfactory operation. Research in this range is leading to constantly improved products.

Turn page ►



IDEAL LIFE TEST on size 306 at 3600 rpm

1 — Typical characteristics of synthetic greases

Grease type	Max temp for 1000-hr. life, F	Lowest temp for 1000-gm-cm torque in 204 brg, F	Approx cost $/lb
Silicone	340	−30	6.50
Polyester	300	−50	2.00
Silicone-diester	280	<−100	6.50
Diester	270	−70	2.00
Polyglycol	250	−30	1.75
Petroleum	250	−20	0.20

2 — Guide for maximum relubrication periods

Type of service	Motor horsepower ¼-7½	10-40	50-150
Easy: Valves, Door openers, Portable floor sanders, Infrequent operation (1 hr/day)	10 years	7 years	4 years
Standard: Machine tools, Air-conditioning apparatus, Conveyors, 1 or 2 shift, Garage compressors, Refrigeration apparatus, Laundry machinery, Textile machinery, Woodworking machines, Water pumping	7 years	4 years	1½ years
Severe: Motors, fans, pumps, M-G sets, running 24 hr/day, 365 day/yr, Coal and mining machinery, Motors subject to severe vibration, Steel-mill service	4 years	1½ years	9 months
Very severe: Dirty, vibrating applications, Where end of shaft is hot (pumps and fans), High ambient	9 months	4 months	4 months

Grease types and important grease properties

Greases available for electric-motor use can be segregated into two classes. The first includes well over 95% of grease used in industrial motors today. These are made with petroleum oils that are thickened with several dozen varieties of metallic soaps, or non-melting, non-soap thickening agents. The second class includes greases using synthetic fluids with various thickeners. They are coming into continually broadening use for extreme-temperature industrial applications in heat-treating equipment, furnaces, air-conditioning units, outdoor applications in cold climates and refrigeration units.

Petroleum greases. Some characteristics of typical petroleum greases are shown in Table 3, next page, which is intended to give some idea of the general range of properties which might be expected of the various types of petroleum greases. There are extreme variations in physical properties and performance characteristics in a group of greases within a given soap type, so care must be given to the selection of specific greases for difficult applications. Of those listed, sodium, sodium with about 20% calcium, and lithium soaps are the most generally used greases for electric motors.

Lithium soap greases have come to the forefront in the past ten years. Since they have reasonable resistance to water, good high- and low-temperature characteristics and good mechanical and oxidation stability, they are finding wide use in multipurpose industrial applications as well as electric motors. Some lithium greases are used as all-purpose lubricants in a number of major steel and aluminum producing plants under a great variety of conditions. While not yet equivalent to soda-base greases under some unusual operating conditions, lithium soap products are being continually improved and production is expanding rapidly.

Sodium soap greases have been for years the most widely used rolling-bearing lubrication, including electric-motor bearings. They are generally characterized by satisfactory mechanical stability, good rust-preventive action and wide temperature usability. About 20% calcium soap is often incorporated to shorten fiber length and give a more uniform structure. Greases containing a large proportion of soda soap have excellent rust-preventive properties. They are washed away by large quantities of water, however, leaving the bearing unprotected. In such cases, very frequent relubrication must be practiced or else a water-resistant grease of the lithium, calcium, barium, or strontium type should be used.

Calcium soap greases have good water resistance, smooth texture, moderate price and are easily manufactured. However, their generally poor

3 — Typical characteristics of petroleum greases

Base	Texture	Dropping Point, F	Maximum temp for continuous use, F	Water resistant	Mechanical Stability
Soap					
Aluminum	Smooth and stringy	190	150	Yes	Poor
Barium	Buttery or fibrous	400+	250	Yes	Good
Calcium	Smooth and buttery	210	175	Yes	Fair
Lithium	Buttery to stringy	400	250	Yes	Good to poor
Sodium	Buttery or fibrous	400	250	No	Good to poor
Strontium	Buttery or fibrous	400	250	Yes	Good
Nonsoap					
Modified clay	Smooth	500+	250	Yes	Fair
Silica gel	Smooth	500+	250	Some	Poor
Carbon black	Smooth	500+	250	Yes	Good

4 — Typical specifications for today's motor greases

Properties	Open bearings, general purpose	Double-sealed bearings	High temp (–30 to 325 F)	Low temp (–65 to 210 F)
Worked penetration	265-295	230-280	270-300	260-300
Oil type	Petroleum	Petroleum	Silicone	Diester
Oil viscosity, sus at 100 F	400-550	400-550	———	———
Soap type	Li	Na, Li	Li	Li
N-H bomb (minimum hr for 20-psi drop at 210 F)	750	750	1000	750
Bleeding (maximum weight % in 500 hr at 212 F)	10	5	7*	8*
Evaporation, (maximum weight % in 500 hr at 212 F)	6	2	2*	4*
Dropping point, deg F minimum	330	340	415	325
Performance				
Low temperature limit for 1000 gm-cm torque, deg F	–20	–20	–30	–65
Minimum 306 bearing life, hr at 3600 rpm, 212 F	10,000	5000	1500**	1500
Maximum micropenetration after 25 hr in overpacked 306 brg***	250	150	150	150
Rust protection	Yes	Yes	Yes	Yes
Compatibility with other approved greases	Yes	——	Yes	Yes

* In 100 hours ** At 302 F *** ASTM Bulletin 147, p 81, 1947

mechanical stability in rolling bearings usually eliminates them from consideration for electric-motor bearings. Older types of calcium greases contain water as a stabilizing agent which limits their use to temperatures below 160 F. Some newer calcium-soap greases are being developed without water as a stabilizing agent and their good mechanical stability will justify their consideration for electric motors.

Barium greases find considerable use in electric motors because of generally good mechanical characteristics and also their good resistance to water.

Strontium greases are sometimes used above normal temperatures around ovens, smelters, and processing units operating in presence of steam.

Aluminum greases are rarely used in motor ball bearings due to their poor mechanical stability in rolling bearings and upper temperature limit of about 150 F.

Inorganic thickeners of clay and silica gel are being developed as replacements for soaps commonly used in multipurpose industrial greases. These are characterized by non-melting properties and resistance to water washing. Unfortunately, poor rust protection, high bearing torque and improper feeding characteristics have been experienced with some of these greases, making them seem poorly suited for electric-motor service. Despite their very high dropping points, upper temperature limits for long-time service in electric motors has not been raised by their use. Research is now in progress to alleviate some past difficulties.

(*Continued on page* 200)

Water and steam sampling and testing: guides to trouble-free operation

Knowing where and how to spot sampling tubes and cooling coils makes a lot of difference in getting accurate test results. Here's practical info on these important subjects.

By D C SWIFT, *Ebasco Services Incorporated*

► PROPER sampling and testing are necessary for control of water treatment effectiveness. The paragraphs below tell you how to go about making the checks, how to avoid the common pitfalls.

WATER SAMPLING

A water test is no better than the sample taken. So consider carefully the sampling point and collection technique. If water is being diluted, blended or treated, sampling point must be far enough downstream to allow mixing. Water tends to flow in laminar streams; it may not mix and diffuse completely for an appreciable time.

In a reservoir or tank there may be so little movement caused by mechanically or thermally induced circulation, that there is considerable difference between water quality at top and bottom of the tank. In an open flume, baffles help mix chemicals more rapidly with the water being treated. A control sampling point can then be spotted shortly after point of chemical addition.

Failure to sample the treated water at a point where complete mixing has occurred often makes treatment by adding a particular chemical unsatisfactory. A pump usually assures complete mixing; but pump may be far enough downstream to introduce undesirable time lag in sampling and control.

Boiler water samples are usually taken from main steam drum of blowdown line, wherever concentration is highest. This tends to accentuate the differences in water quality as shown. But it is often desirable to take special samples from other drums or waterwall steam drum may affect water sample. headers. Height of sampling point in a Don't locate sampling point so high that it is uncovered during heavy boiling or slightly low water level. You may get a sample of pure or partially diluted condensed steam instead of boiler water. If sampling point is too low or too far on one side, sample may be partially diluted by incoming feedwater or treatment chemicals.

In a long boiler drum, there may be material differences in water concentration caused by (1) uneven firing rate or (2) uneven resistance to water flow in the water-steam circulation path. If one side of a boiler is heated more than the other, more steam is released and water becomes more concentrated on that side.

Surprisingly, there does not seem to be much tendency for mixing and equilization across the boiler. Uneven flow path resistances do not ordinarily cause much distortion in concentrations if heat input and feedwater inflow are uniform across the boiler.

The side with high resistance and lower flow concentrates slightly more with evaporation of a given quantity of water. But this concentration is at once reduced to normal as the incoming feedwater mixes with the lesser quantity of circulating boiler water. If feed is not even across the drum, concentration in low-feed zones equalizes at a higher level than it does in high-feed zones.

For routine sampling of boiler water, use a pipe extending the length of boiler drum or from continuous blowdown line. Seal end of the pipe and space a number of small inlet holes uniformly along it. If you have trouble, or find evidence of unusual deposits, install several sampling lines.

Total area of the holes should be about 50% of the pipe area. This permits drawing in fairly uniform sample quantities at each hole. But if holes are too small they may plug up. A 3/32-in. diameter is a good minimum. Putting them on side or bottom of the pipe reduces tendency for plugging.

Sampling pipes outside of the boiler drum must be able to withstand maximum boiler pressure. If too large, the time required to flush out the line and obtain a representative sample increases. Too-small pipe tends to plug. Usually ⅜ or ½ in. pipe is good; 1-in. gives more mechanical strength.

Water samples are frequently taken at high temperature, then cooled to approximately room temperature. Don't insulate sample pipes except where someone may get burned.

Throttle at the cooler coil outlet. This way sample remains under full pressure until cooled to a point where it cannot flash. If a hot sample flashes, its apparent concentration increases, and

dissolved gases may be released.

Provide shutoff valves at the point of sampling and at cooler inlet. If distance from sampling point to cooler is short, you can omit the latter valve. Connections to permit withdrawing samples for oxygen determination without contacting the air are imperative. Arrangements for collecting oxygen and general analysis samples simultaneously or for permitting part of the sample to flow to waste continuously may be desirable.

STEAM SAMPLING

Steam sampling is more difficult than water sampling. Impurities are usually present in water droplets or as tiny dry particles. Although these travel with the steam, they are apt to be badly stratified. Best place to take samples from pipelines is from a long vertical run. Then water droplets are mixed across the pipe area, instead of running along the bottom, as they might do in a horizontal run.

Follow ASME recommendations for nozzle location and obtain a representative sample using a special ASME sampling nozzle.

Checking for carryover. When checking boiler for carryover, sample steam at either boiler or superheater outlet, or both. Amount of solids in steam leaving the superheater is particularly interesting. These solids are an important cause of turbine blade deposits. Comparing solids in steam leaving superheater with solids entering it may indicate a considerable decrease. Dry solids in the steam may be deposited on the superheater elements. The layer of chemicals thus built up may burn out the elements. But more often than not, the solids pass right through the superheater as dry particles.

Steam lines between boiler drum and superheater inlet are often short and curved. This makes it difficult to get a good sample for comparison with steam leaving the superheater. You can take steam from the boiler steam drum after steam purifiers through one or more sampling pipes. On larger boilers, install several sampling lines across the width of the drum or on crossover tubes to superheater inlet header. This shows steam quality along the length of the drum.

You may find that a leaky steam baffle joint or improperly placed baffle or screen is causing steam contamination at one spot, thus lowering quality of the entire steam output. Individual sampling points may give a clue to the exact location of the trouble.

Sometimes it is necessary to sample steam above steam-releasing surface of drum water and after each step of cleaning equipment (separators, baffles, washers, etc). Such a complicated setup is warranted only in a severe case of carryover trouble that cannot be run down and corrected by ordinary sampling and physical inspections.

Boiler steam sampling lines must be heavy enough to withstand the pressure and temperature of the sample point. Lines inside a boiler drum do not have to withstand the full pressure difference between drum and atmosphere and hence need only be heavy enough for good mechanical strength. Using stainless steel for high temperature samples lessens the possibility of contamination. It also reduces troubles from rust particles that may plug or restrict cooling coils and control valves.

Boiler sampling points for steam or water are usually rather high up and remote from the point where convenience dictates locating cooling coil. To reduce time lag, size of cooling coil and cost of sampling line, use either ¼ or ⅜-in. pipe. Lines should slope about ½ in. per foot for drainage, particularly if they are subject to freezing. Insulate where necessary to protect operators from burns and pipes from freezing. Otherwise, leave pipe bare to assist the cooling coil in condensing the sample.

Provide valves at point of attachment to the boiler or steam line and at the manifold ahead of the cooling coil when more than one sampling line uses a coil. Best practice puts a regulating valve at coil outlet to keep sample under pressure as it condenses, and prevent release of gases, if any.

It sometimes takes hours or days of operation for a steam sampling line and coil to become well cleaned and purged. So use a common coil for a number of lines only when the samples have similar purity and other characteristics. Never use the same sample line or cooling coil for both boiler water and steam sampling.

Provide an adequate supply of cold water to cool sample to 70 F, drainage lines for spent cooling water, and a thermometer to show sample condensate temperature. Arrange sample connections from cooling coil so condensate may be passed continuously through a conductivity cell. Use a rate no greater than 1.5 gpm to avoid error from streaming potential. The water inlet should be near bottom of cell with flow across cell to outlet near the top. You also need a parallel drain path so you can by-pass the conductivity cell and deliver sample either to a sampling flask or to waste. Use this drain for blowdown.

Cooling coils are ordinarily made of two continuous lengths of copper or stainless-steel tubing, one inside the other. Cooling water should run counter to sample flow for best results. When possible, bring sample in at the top and drain from the bottom. This cuts time lag since coil is freer from water.

Points to consider in locating sampling coil: It should be located (1) as close to sampling point as possible and preferably below it (2) so that cooling water and drain connections are not unduly expensive (3) where conductivity cell can be readily checked for condition and sample temperature (4) where samples can be drawn safely and conveniently. If conductivity cell is to be connected to a recorder, provide electrical leads.

Never use the coil without a dependable supply of cooling water. Overheating and possible coil damage may result. If water pressure fails or is improperly adjusted, sample temperature may rise enough to damage the conductivity cell, or it may burn a man who is collecting a sample.

When adjusting cooling water flow, see that it is adequate. It takes several minutes for temperatures to stabilize after each new adjustment. Valve settings to give fairly full flow on both sample and cooling water lines are less critical. They are less affected by scale particles or thermal expansion in valves. Sampling time lag is also reduced by the higher flows. But you must strike a balance between these advantages and the higher loss of sample condensate and cooling water.

High-pressure sampling. For high-pressure sampling, use an orifice to partially or entirely control flow, and a plug-type valve designed for throttling service. Provide regulating valves with position markers so valve settings can be recorded and duplicated.

For accurate steam sampling, particularly if there is entrained water, draw steam into sample nozzle holes at the same velocity as the steam moves in the main pipe. Knowing steam conditions and area of nozzle holes, you can adjust the rate of sample collection to give desired inlet velocities.

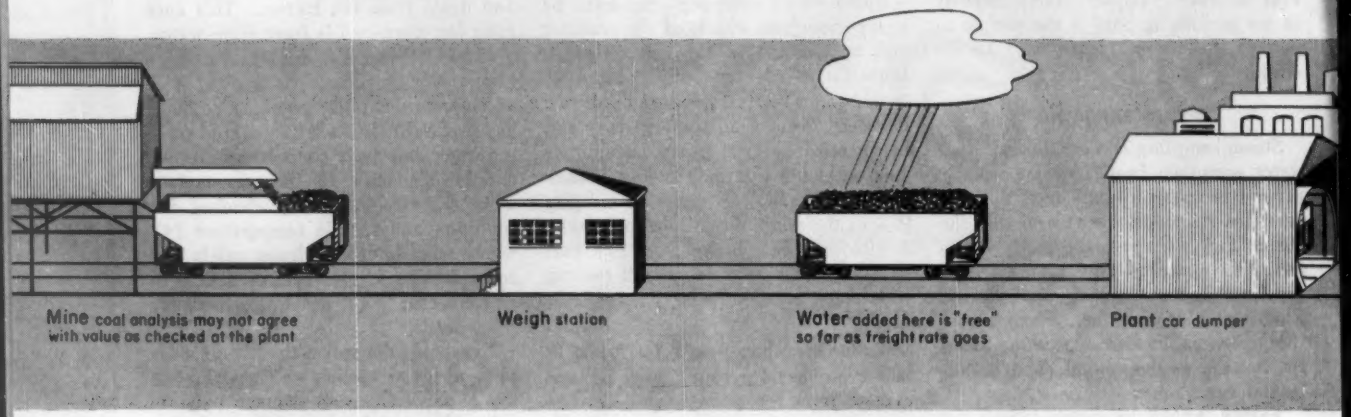
Considering condensing capacity of the cooling coil, calculate the desirable size and number of sample nozzle holes before fabrication and installation.

WATER TESTING

The usual power-plant water tests are

(*Continued on page* 214)

Point of sampling may affect Btu value found in the coal


Mine coal analysis may not agree with value as checked at the plant
Weigh station
Water added here is "free" so far as freight rate goes
Plant car dumper

What does coal heat value mean? Do you get the guaranteed value? How do you figure price adjustments? C W Stevens, Dayton, Ohio, says . . .

Let's standardize our methods

► WHEN A COAL DEALER *guarantees* his coal at, say *13,000 Btu*, and quotes his price on that basis, you have to understand what he means. And you need an arrangement for adjusting price of the coal as received.

First, let's define the term *13,000 Btu*. Normally, *13,000 Btu per lb of coal as received* is the phrase used. This generally means as received and sampled at the destination or using plant. Point of sampling may greatly affect heat value as determined in the laboratory.

In our case the coal mines in southern West Virginia are about 250 miles from our plant. The railroad-track scales are about half way between the mines and our plant. If a heavy rain occurs between mine and scales, the water is weighed. If rain falls on our end of the journey, we do not pay freight on the added weight of water. In either case, coal values in the actual firing suffer.

If the mine laboratory samples and analyzes the coal at the source, Btu as received may be different from the value obtained at our plant. So, since the difference affects guarantee, you can argue which is the proper value. One way to solve this is to handle all prices, analyses, values, etc, on a dry basis. But here again, the point of weighing and sampling should coincide so payments and true values are beyond argument.

Boiler operators think only in terms of the coal they actually burn. They want heat values as received in their bunkers, ground in their pulverizers, burned in their boilers.

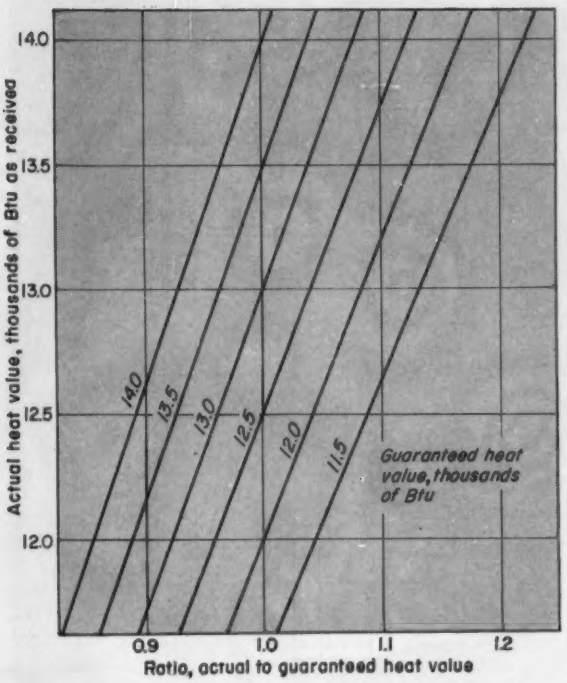
Since our plant has a good laboratory and an automatic coal-sampling system, we arbitrarily set up our plant as the guarantee point. Our mechanical sampler is at the end of the second conveyor belt from the car dumper. Coal has been crushed and turned over several times before the device picks out its 60 increments and 1000-lb sample from each car tested. Thus the entire carload is thoroughly mixed before we take our sample from it.

Since we use mostly carbon size, ¼ x 0 coal, we believe the effect of travel rain is negligible compared to its effect if car-top samples were taken. In many modern preparation plants where all coal is washed, operating conditions outweigh rain in affecting amount of moisture in the coal.

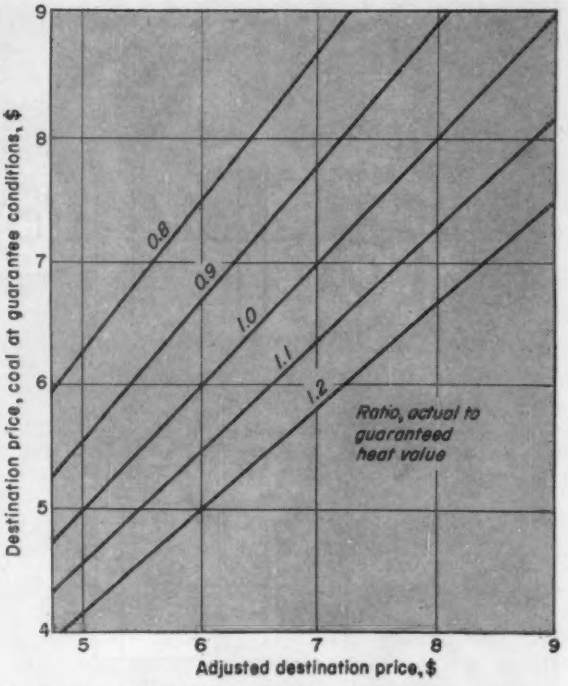
Based on the facts outlined above, our definition is *Btu per lb as received at destination*. Thus our sampling and analysis become the determinant. Up to this time we have had no disagreements. We often exchange samples with the mines, at the suggestion of new suppliers, to establish confidence in this relationship.

Fulfilling the guarantee. Now we can go to the question of fulfilling the guarantee and appraising values for determining adjustments or penalties.

There are many methods that could be used, but the three illustrated below are the most common. I think it would be a boon to industry if our coal associations and engineering societies could develop a universally ac-



1 These curves substitute for calculations in determining the ratio of actual to guaranteed heat value in the coal



2 Adjusted destination price includes adjusted mine price plus freight charge. Price varies with coal heat content

# of appraising coal values

ceptable formula for evaluating coals, from both a quality and price standpoint.

1. Adjustment per 100 Btu per lb over or under the guarantee. This is the simplest method. If destination price at our plant is $6.50 per net ton for coal guaranteed at 13,000 Btu, the cost per net ton per 100 Btu is $6.50 ÷ 13,000/100 = $.05.

The adjustment then becomes ± $.05 per 100 Btu over or under 13,000 Btu as received. It is customary to neglect differences within 100 Btu either way, but to make full correction when variation is more than this. For example, if the laboratory finds heat value is 12,890 Btu, 110 below the standard of 13,000, adjustment becomes 1.10 × $.05 = $.055 per net ton of coal. Based on an original mine price of $4.00 with a freight billing rate of $2.50, price becomes $3.945 per net ton, fob mine.

2. Adjustment based on cost per million Btu as received. Continuing the above example, the cost per million Btu as received is ($4.00 + $2.50) ÷ 13,000 Btu per lb × 2000 lb per ton/ 1,000,000 Btu = $.25.

If value is actually 12,890 Btu per lb, destination price should be $.25 × 12,890 Btu per lb × 2000 lb per ton / 1,000,000 = $6.445 per net ton. Mine price is then $6.445 – $2.50 freight = $3.945 per net ton.

3. Adjustment based on ratio of heat values. This method simply adjusts the destination price in proportion to the actual laboratory measurement of heat value, and its ratio to the guaranteed value.

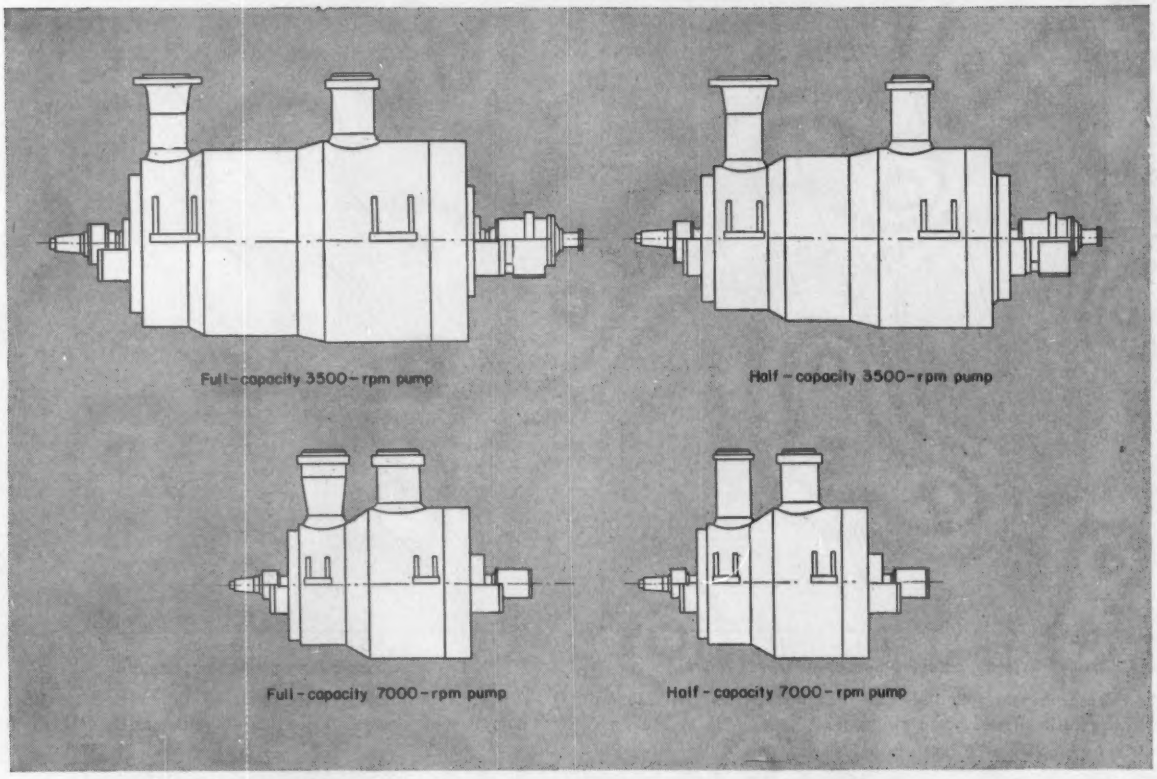
Following the same example, we have (12,890 / 13,000) × ($4.00 + $2.50) = $6.445, adjusted destination price. Adjusted mine price is again $3.945 per net ton.

The three methods give the same answer. In our area, method 1 is used the most, method 3 the least. Method 2 seems to be used where most careful computations are made and where costs per million Btu are used to compare coal qualities are received at the plant.

Many firms using method 1 use the same adjustment value, generally $.05 per 100 Btu, for all their coals regardless of price, freight charges or heat values. This penalizes the low-cost coals, gives the high-cost coals an advantage. For example, if destination price is $6.00 per ton, guaranteed at 12,500 Btu per lb, adjustment should be 4.8 cents per 100 Btu. At $7.00 and 13,000 Btu, adjustment should be 5.4 cents; at $8.00 and 13,500 Btu, it should be 5.9 cents.

You can set up curves like Figs. 1 and 2 to help determine adjustments based on ratio of actual to guaranteed Btu. These curves use method 3, but similar curves or tables can be set up for any method of figuring.

In determining adjustments, usually no reference is made to firing or steaming capabilities of the coal, in terms of lb steam evaporated per lb coal. These evaporation rates generally follow coal heat content fairly closely except where there are limitations in equipment that favor firing certain types of coals.



1 Size comparison of four different feed pumps designed to deliver full or half capacity, as marked. Note effect of higher speed on the pump size. High-speed feed pumps offer a number of advantages in the modern central-station plant

Economics of main-turbine drives for central-station boiler-feed pumps

By IGOR J KARASSIK, *Assistant to Vice-President, Worthington Corporation*

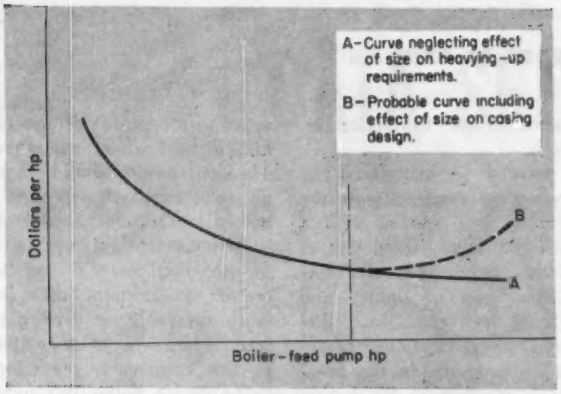
► RECENTLY, there has arisen a considerable amount of speculation over possibilities of driving a full-capacity boiler-feed pump directly from the main turbine-generator unit of a high-pressure steam-power generating station. This idea is not exactly new. As a matter of fact, invention of the steam pump by Henry Worthington in 1840 was prompted by the desire to abandon the same type of arrangement. Until then, the feedwater pump was operated directly by the steam engine which it served.

But the fact that an idea or mechanical arrangement was once discarded should never serve as a reason for not reconsidering it at a later date, in light of changes and improvements that have occurred in the interim.

We shall not concern ourselves with an exact quantitative evaluation of this drive method compared to all other conventional methods. We'll merely give an indication of various factors that enter into such an evaluation.

Advantages. Major advantage of driving a full-capacity boiler-feed pump from an extension of the main turbine-generator shaft is the savings made by elimination of an independent drive. Not only is it unnecessary to acquire a separate driver, but net capability of the generator is not reduced by the power needed to drive the feed pump. Only necessity is to provide the main turbine with the required power margin over the generator capability.

These savings are impressive. A 200,000-kw unit operating at 2400 psi and served by three half-capacity pumps (two running and one standby) would require installation of three 3500-hp motors. If 3600-rpm pumps were used, cost of these three motors would be close to $240,000, not including transformers or controls. (Use of high-speed pumps driven by 1800-rpm motors and stepup gears might reduce cost of the drivers by some 10%). If a full-capacity boiler-feed pump is connected to the main turbine-generator, at least two of these motors can be eliminated. In addition, size and cost of the gen-


A–Curve neglecting effect of size on heavying-up requirements.
B–Probable curve including effect of size on casing design.
Dollars per hp
Boiler-feed pump hp
A
B

2 Relative costs of high-pressure boiler-feed pumps. Note how the cost increases beyond a certain maximum rating

The author shows:

Main-turbine drives offer impressive savings today

Control of the pump does not present difficulties

Net capability of generator is not reduced by pump

Design problems are few

erator could be reduced. If, on the other hand, generator size is left alone, value of the incremental kilowatts can easily be evaluated.

Costs. Studies of steam-turbine drive and main-turbine generator drive have indicated further possible savings. These result from substitution of a 2.4-kv auxiliary power-system voltage for the 4.16-kv system required with the large motors presently used on boiler-feed service. Note, that since a starting and standby pump of possibly half-capacity would be included, these savings are really not available and should not figure in the cost analysis.

Effect of the arrangement under discussion on the cost of the boiler-feed pumps will have to be considered in detail after the problems introduced in the construction of the pumps have been analyzed. At the same time, we can state that, if the cost of the pumps in terms of dollars per hp is assumed to remain relatively constant or even to decrease slightly in the range of sizes involved, there should be no appreciable difference between cost of one single full-capacity unit and two half-capacity pumps. The standby half-capacity pump represents an investment common to both arrangements.

Controls. The control problem presents no difficulties. The boiler-feed pump would be driven through a hydraulic coupling which would provide variable-speed operation exactly in the same manner as when an independently driven boiler-feed pump is connected to its motor through a hydraulic coupling. This arrangement will also permit (1) disconnecting feed pump from the main turbine by draining oil from the hydraulic coupling in case of emergency (2) replacing main feed pump in service by an independently-driven standby pump.

However, there are factors that react unfavorably on the main-turbine drive arrangement when compared to an independent turbine drive. These could easily be overlooked. To begin with, there will be a power loss due to slip of the hydraulic coupling, even at full-rated conditions. Adding to it the fixed horsepower losses of the hydraulic coupling, minimum losses will be about 3.5%.

In addition, it is necessary to provide a boiler-feed pump with sufficient margin to take care of boiler swings and to compensate for pump's ultimate wear. If the pump is driven by an independent steam turbine, this margin can be eliminated or reduced since turbine's speed can be increased slightly whenever necessary to provide this margin. If, however, the pump is driven from the main turbine, rated conditions of the boiler-feed pump must incorporate this extra margin in capacity, a margin that normally runs to about 8%.

Assuming an adequate pressure margin is incorporated to take care of rise in the system-head curve with an increased capacity, additional loss will occur in the hydraulic coupling when operating at reduced speed to meet the exact head and capacity required for full load. Thus, total loss under normal operating conditions chargeable to the hydraulic coupling may be about 6 to 8% when compared to independent turbine drive. These losses are wiped out in a comparison with motor-driven pumps with hydraulic couplings.

Design. What, then, are the design problems of such a full-capacity pump? Hydraulically there is no particular difficulty. In the pressure range we are considering, it is no more difficult to design a pump for, say, 4000 to 6000 gpm than one handling 2000 or 3000 gpm. True, larger pumps will require higher net-positive suction-head (npsh) values. However, if a closed feedwater system is used, condensate pumps can furnish sufficient npsh. If feedwater system is the open type, booster feed pumps can be used. As a matter of fact, a motor-driven booster pump could serve the dual purpose of providing npsh to the main feed pump and building sufficient boiler pressure for a cold start.

However, when we consider mechanical problems imposed by driving a full-capacity boiler-feed pump at 3500 rpm (3600-rpm synchronous turbine speed less hydraulic slip) we find certain disadvantages are introduced.

Main problem concerns the high-pressure bolting of a full-capacity pump. Because of larger capacities involved, the pump-casing diameter and internal areas subject to discharge pressure will increase over those of the half-capacity pump to accommodate increased internal water passages. Effect will be to increase bolt stresses and make the pump considerably heavier. As a result, it may not be quite right to assume cost in dollars per hp of such a pump would be unaffected by increase in size. Instead, we may look for a discontinuity in the curve of dollars per hp versus size at 3600 rpm and expect an appreciable increase, once a certain maximum is passed, Fig. 2.

Limitation of pump speed to 3500 rpm would work quite a hardship on the boiler-feed pumps intended to serve a super-pressure steam power plant.

(Turn page)

"...no insurmountable problems appear to exist..."

While design problems are not unsurmountable, a 3500-rpm boiler-feed pump required to handle 4000 to 6000 gpm against a pressure of 4500 to 5500 psi in a single casing reaches almost monstrous proportions.

Nor is it practical to use two pumps in series, operating in tandem. Objection to this stems from the maintenance angle since dismantling of high-pressure pumps takes place axially and the tail-end pump would have to be removed to gain access to the pump nearest the main turbine. This would involve breaking the pipe connections and would not be tolerated by power-plant personnel.

Solution. Logical solution is to use high-speed pumps, operating at speeds of 6000 to 9000 rpm with stepup gears interposed between the hydraulic coupling and the pump. There is no need to discuss merits of the high-speed boiler-feed pump nor to present all the arguments which led to this latest development in steam power-plant practice. Recent technical literature has treated the subject quite thoroughly. Suffice it to say that the high-speed pump presents major advantages when independently driven, none of which are sacrificed when the pump is driven by the main turbine. A graphic demonstration of the effect of high speed is presented in Fig. 1 which shows the relative dimensions of 3600-rpm and high-speed boiler-feed pumps.

Other problems. There remains a psychological problem to consider—the possible effect of interruption of service due to boiler-feed pump failure arising from circumstances beyond the pump manufacturer's control. There is no question that the intrinsic reliability of the modern boiler-feed pump has reached levels of the magnitude of the boiler or the main turbine themselves. It is quite normal to expect from 60,000 to 120,000 hr of operation before overhaul of a high-pressure boiler-feed pump is necessary.

There are, however, certain operating hazards that confront the feed pump and have no equivalent counterpart in the boiler or steam turbine. Perhaps the most important of these is the possibility of foreign matter being introduced into the pump. This may consist of mill scale or loose particles of brittle black oxide. It generally finds its way into the pump during the early part of its operating life, frequently during the first few weeks. Catastrophic effect of such an occurrence is too well-known to power-plant operators to require further discussion.

Another hazard is introduced by transient operating conditions in the case of an open-feed system, with a direct-contact heater at the suction of the boiler-feed pump. We refer specifically to the effect of sudden and large reductions in turbine load that result in a rapidly decaying heater pressure and, frequently, in the flashing and steam binding of the boiler-feed pumps.

A failure of this kind need not shut down the entire unit, as long as a half-capacity independently-driven boiler-feed pump is installed. But, reaction of operating personnel would obviously require heroic measures be taken immediately to restore the main pump to service. Real problem arises from the paradoxical situation that operating personnel will accept a shutdown of up to eight weeks to correct turbine or generator difficulties but will become restive after a pump has been shut down for three or four days. Such an attitude is possibly fostered by the erroneous idea that downtime for maintenance should be proportional to investment value of the equipment. Nothing could be further from the truth. A high-pressure boiler-feed pump is a complex piece of machinery and requires precision parts that should be designed not for ease and rapidity of overhaul but rather for infrequency of same. The two requirements are, unfortunately, incompatible.

Returning to the question of "heroic measures," we find that the relative investment in the two pieces of equipment we are comparing—the feed pump and turbine-generator—does not permit an equal investment on the part of the manufacturer in "spare" erection and service personnel or even in spare parts. As far as the latter are concerned, it would be necessary for a utility to revise present-day policies on spare-part inventories for feed pumps so as not to saddle the pump manufacturer with an unfair burden. After all, expense of maintaining increased inventories would have to be added to normal manufacturing costs and passed on to the purchaser. This would be an intangible cost that the purchaser would probably prefer to see reflected "physically" in his own warehouse.

As to "spare" service and erection facilities, this is no doubt an added insurance of contingency cost that the manufacturer would have to incur in order to render the service expected of him in case of an emergency failure. The purchaser should therefore understand this and expect to see it reflected in the equipment cost.

Arrangement. It may be interesting to note that there is one turbine-generator arrangement that lends itself more favorably to driving the boiler-feed pump—a cross-compound unit. In this case, each generator drives a half-capacity boiler-feed pump, preferably through a stepup gear. No reduction in plant load need occur in case of outage of one pump, since a third half-capacity independently-driven standby pump would be included in the installation.

New units. Our company is presently building six pumps to serve two 275,000-kw cross-compound machines operating at 2400 psi. Each unit will have three 4-stage boiler-feed pumps operating at 8475 rpm and designed to handle 1 million lb per hr against a discharge pressure of 2860 psi. Two pumps will be connected to the 3600-rpm generators of the cross-compound unit through hydraulic couplings and stepup gears. The third pump, on standby service, will be driven at constant speed by an electric motor and gear. A feedwater regulator will be incorporated in the discharge of the standby pump before the junction with the main header to permit any combination of pumps to operate in parallel.

Study. At the inception of the study for this installation it was considered necessary to incorporate a disconnect clutch between the generator and hydraulic coupling. Its function would be to permit work on the hydraulic coupling without stopping the main unit. Obviously, the feed pump can be taken off the line by draining the hydraulic coupling oil.

This clutch was finally eliminated from consideration, because it would be as vulnerable, at best, as the hydraulic coupling. Thus, overall availability of the equipment installed would be reduced rather than improved by the disconnect clutch.

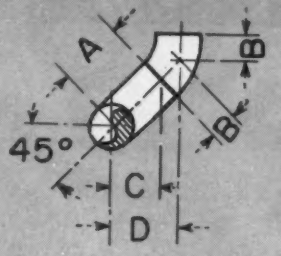
In conclusion, we can state that no insurmountable problems appear to exist in driving boiler-feed pumps from an extension of the turbine-generators, when such an arrangement is economically justifiable. The only requirements are the complete understanding of the problems involved by both the manufacturer and user, and the mutual desire to solve these problems.

Power's DATA SHEET

No. 293

Welding long-radius 45- and 90-degree elbows

By W A ROSTAFINSKI
New York, N. Y.



Nominal pipe size, in.	A	B	C	D	E
2	3	1 3/8	2 1/8	3 1/16	1 15/16
2 1/2	3 3/4	1 3/4	2 5/8	3 7/8	2 1/2
3	4 1/2	2	3 3/16	4 5/8	2 13/16
3 1/2	5 1/4	2 1/4	3 11/16	5 5/16	3 3/16
4	6	2 1/2	4 1/4	6	3 9/16
5	7 1/2	3 1/8	5 5/16	7 1/2	4 7/16
6	9	3 3/4	6 3/8	9	5 5/16
8	12	5	8 1/2	12	7 1/16
10	15	6 1/4	10 5/8	15	8 13/16
12	18	7 1/2	12 3/4	18 1/16	10 5/8
14	21	8 3/4	14 7/8	21 1/16	12 3/8
16	2'0	10	17	2'0 1/16	14 1/8
18	2'3	11 1/4	19 1/16	2'3 1/16	15 15/16
20	2'6	12 1/2	21 3/16	2'6 1/16	17 11/16
24	3'0	15	2'1 7/16	3'0 1/16	21 3/16
30	3'9	18 1/2	2'7 13/16	3'8 7/8	2'2 3/16

All dimensions to nearest 1/16 inch

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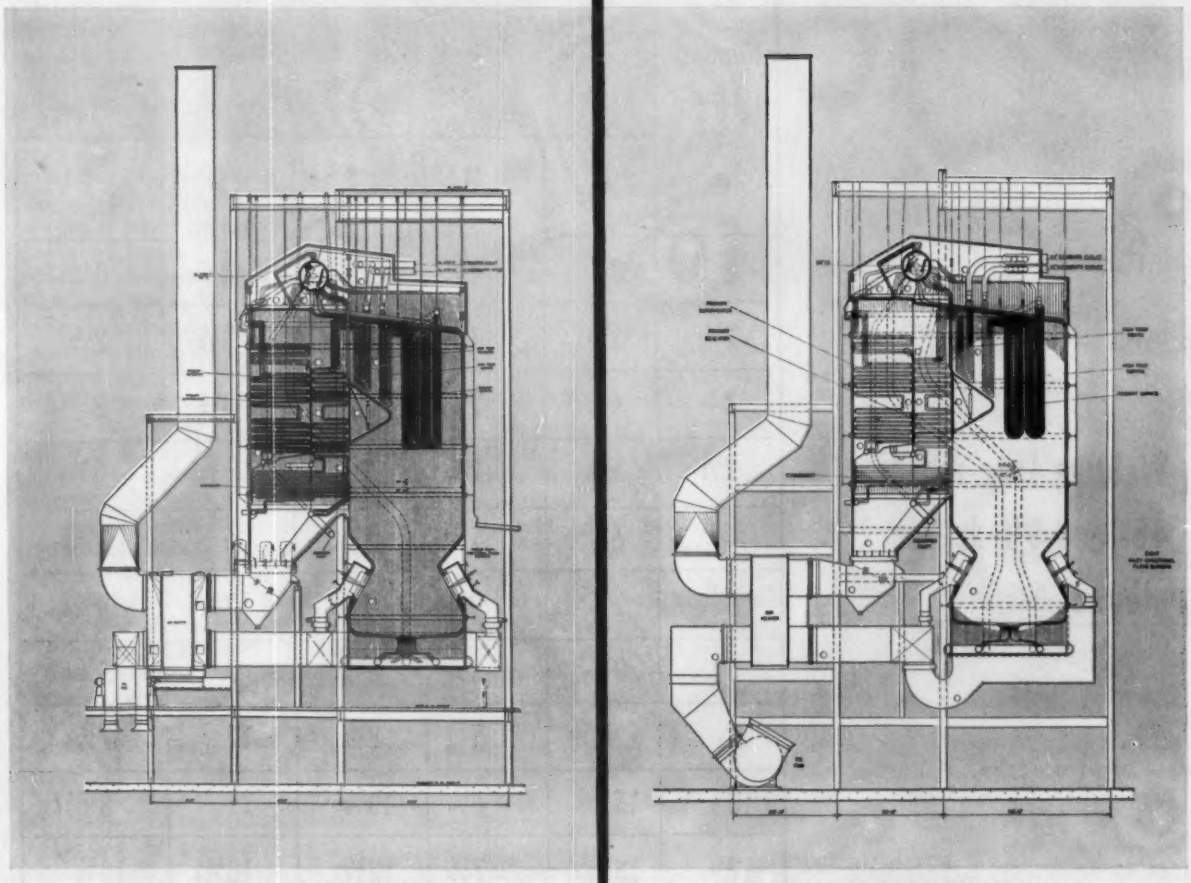
why southern and southwestern

RILEY TURBO



Riley Reheat TURBO FURNACE Unit:
For Texas Public Utility
Capacity: 825,000 lbs/hr. Pressure: 1750 psig design
Superheat and reheat temperatures: 1005 F
Fuels: Natural Gas, Oil, Future Coal
12 Riley Directional Flame Burners
Pressurized Turbo Furnace

Riley Reheat TURBO FURNACE Unit:
For Texas Public Utility
Capacity: 1,250,000 lbs/hr. Pressure: 2125 psig
Superheat and reheat temperatures: 1005 F
Fuels: Natural Gas, Oil and Future Lignite
16 Riley Directional Flame Burners
Pressurized Turbo Furnace

OTHER RILEY TURBO FURNACE UNITS INSTALLED OR ON ORDER

Northeast Paper Mill
One 175,000# Unit
Pulverized Coal

West Va. Chemicals Co.
One 289,000# Unit
Pulverized Coal

Eastern Seaboard
Public Utility
Three 500,000# Units
Fluid Coke

Southern Aluminum Co.
Two 320,000# Units
Gas, Oil, Future Coal

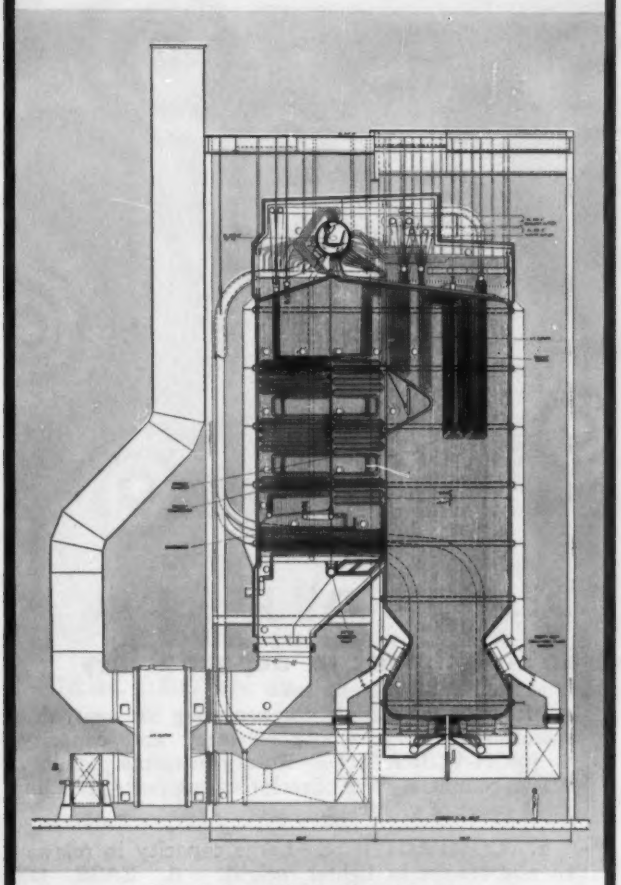
West Va. Chemicals Co.
One 175,000# Unit
Pulverized Coal

Phillipine Islands
Public Utility
One 430,000# Unit
Oil

RILEY DESIGNS, MANUFACTURES AND INSTALLS COMPLETE STEAM GENERATING UNITS AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER AND HEATING PLANTS

public utilities are installing

FURNACE UNITS



Riley Reheat TURBO FURNACE Unit:
Louisiana Public Utility
Capacity: 1,550,000 lbs/hr. Pressure: 2125 psig design
Superheat and reheat temperatures: 1005 F
Fuels: Natural Gas, Future Oil, Pulverized Coal, Lignite, Delayed Coke, Fluid Coke.
20 Riley Directional Flame Burners
Pressurized Turbo Furnace

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

BECAUSE . the TURBO FURNACE makes possible change-over from natural gas and oil to solid fuels firing with minimum of outage and minimum conversion cost . . at the same time it provides a superior, efficient means of firing gas or oil.

When conversion to solid fuels becomes economically advisable the only major expense is the addition of pulverizers. Riley Directional Flame Burners are already equipped with coal heads for easy, quick hook-up to pulverizers.

USES A WIDE RANGE OF FUELS

The method of firing and the high heat and high turbulence in the combustion zone makes possible the efficient and economical use of any fuel that is burned in suspension: gas, oil, all grades of coal, lignite, delayed cokes and fluid coke.

OFFERS MANY ADDED ECONOMIES

- Flyash disposal is eliminated by reinjecting flyash and converting it to slag.
- Minimum carbon loss, higher efficiency.
- Clean furnace — no soot or slag blowing is needed; a large percentage of ash is retained in combustion zone and furnace exit gas temperatures are exceptionally low.
- More uniformity of furnace temperature across superheater and reheater.
- Method of firing makes possible less overall height.
- One level burner operation.

REMOTE AND ELECTRONICALLY CONTROLLED FIRING

Complete automatic and remote firing controls with electronic safeguards are available for Riley Directional Flame Burners.

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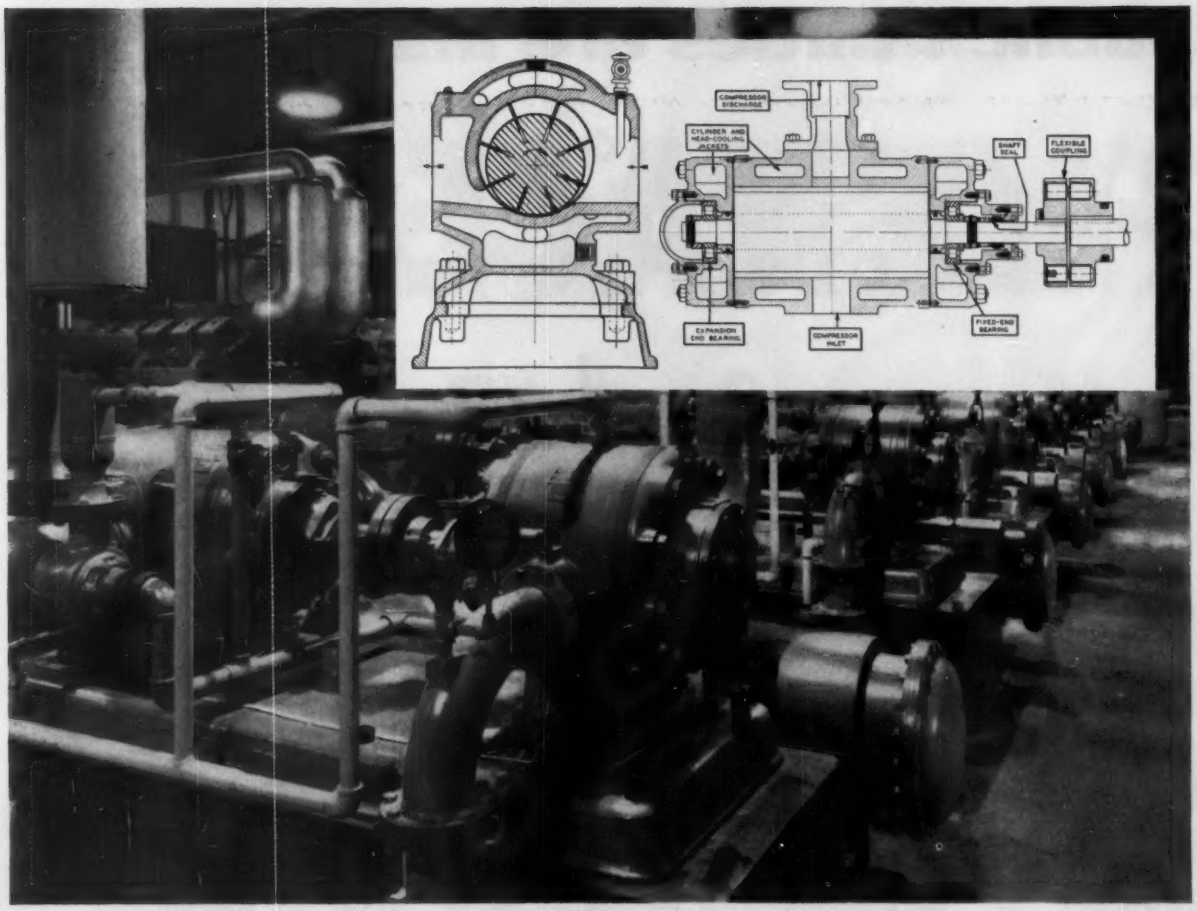
Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.



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. . . in *any* quantity they are an investment in dependability

The wide and continuing acceptance of the Fuller Rotary Compressor in industry is based on a number of unique design features, eminently suited for day in and day out operation in any rugged situation. Indoors or out, its trouble-free operation makes for minimum maintenance and operating costs.

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1. SIMPLICITY—Elimination of compressor valves, crankshafts, pistons and other moving parts greatly reduces the need for attention, adjustment and replacement. 2. PULSATION-FREE FLOW—Rotary compression eliminates pressure fluctuations and simplifies metering problems. 3. SUSTAINED PERFORMANCE—Blades are held out by centrifugal force, automatically compensating for wear, thus maintaining new-machine efficiency and capacity. 4. NON-VIBRATING—Rotary principle permits a design completely free of reciprocating parts, avoiding basic cause of vibration.

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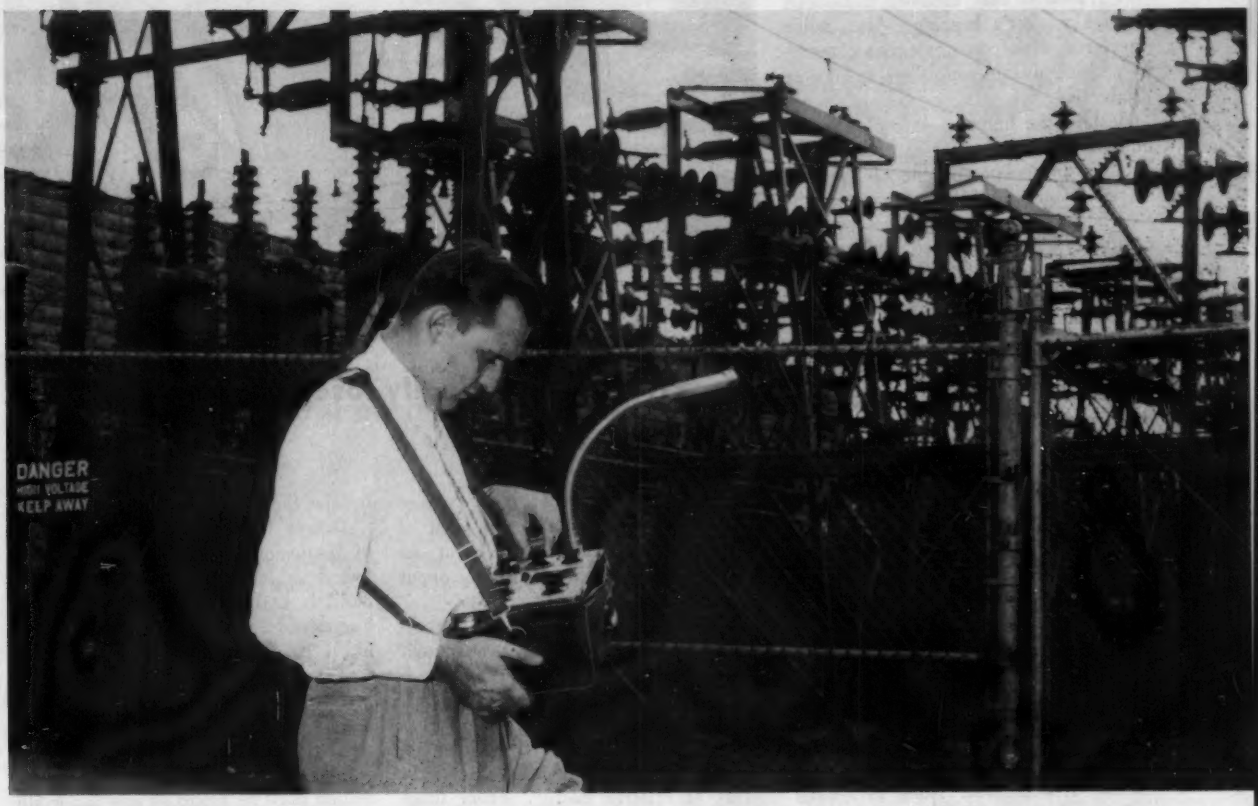
PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

STEVE ELONKA
Associate Editor in Charge



TRACK DOWN and measure noise level with this electronic instrument, then . . .

You can control plant noise

By **NELSON HARTZ**, *Instruments Manager Mine Safety Appliances Co, Pittsburgh, Pa.*

► How would you lick this noise problem? A 10,000-kva transformer was housed in a concrete enclosure in a room beneath an auditorium. Transformer noise was so bad that the auditorium couldn't be used effectively.

First consideration was to learn how noise got to the auditorium. That part wasn't too hard to figure out. Study showed that while concrete housing prevented air-borne noise from reaching auditorium, it didn't stop structural-borne vibrational noise.

Solution. First step taken to solve problem was to reduce noise by placing the transformer on rubber pads. Second, concrete foundation under transformer was separated from concrete slab of room. Third, vibration-isolation ceiling hangers were used to support the large rigid conduits connected to transformer. These hangers were passed through noise insulators at each wall, some distance from transformer.

This is a good example of controlling noise at its source. If noise-source control is impractical, you may be able to control noise along its paths. Mufflers or absorbent material can be used for this purpose. Or construct a special insulating enclosure around the machine's noisy part. But first let's learn something about noise.

Plant engineers who try to control industrial noise must follow a basic pattern. Here are three steps: (1)

Understand nature of problem, its terminology and technology, and select a criterion for judging your situation. (2) Explore the problem with proper measurements. (3) Make corrections where they are needed.

Safety-conscious plant operators now agree that noise control is important. One reason is that untamed noise can harm a worker's hearing. Also, noise interferes with communications, thereby causing unsafe conditions and lower production.

Besides the humane, safety and production aspects of noise control, there's another angle—possible legal liability. To give you some idea of how expensive occupational hearing loss can be, compensation claims filed in New Jersey against one company have amounted to more than $5 million.

Loss of hearing. Occupational hearing loss creeps up on your employees because in early stages it's completely unnoticed by the victim. And, what's more, damage caused to the inner ear by exposure to excessive industrial noise cannot be repaired. Reason: Vibrational energy from excessive noise withers nerve tissues that do not regenerate.

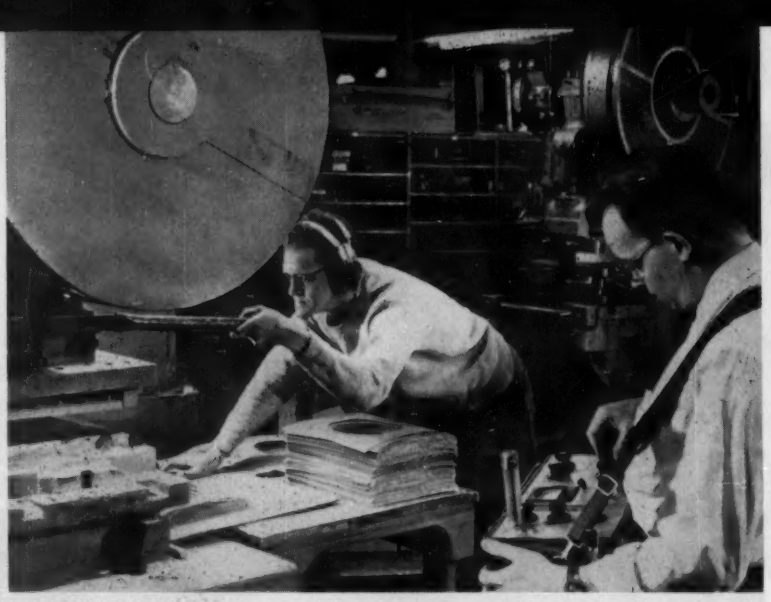
Medical authorities say this hearing loss is irreversible. Worse still, hearing aids don't help persons whose auditory nerve tissues have been damaged in this manner.

What is noise? Before you can reduce or eliminate noise problems you must accurately measure the noise output, then compare with one of accepted damage risk criteria. Noise is usually understood to be unpleasant or unwanted sound. It's caused by waves having two main characteristics, frequency and sound-pressure level.

Frequency, often called tone, is the number of times per second that sound vibrations reach the ear. It's expressed in cycles per second. The human ear has a range of from about 15 to 15,000 cycles per second (cps).

Sound-pressure level is proportional to a logarithmic ratio between the smallest sound that can be heard by a normal ear (reference pressure) and any other sound. The layman calls this loudness, but to a technician loudness is a subjective judgment, combining both sound-pressure level and frequency. The decibel is a measurement unit used to express the sound-pressure level. It indicates the magnitude by which one sound-pressure level is greater or less than another.

Measuring noise. Noises measured in a quiet suburban home at night have a sound level of about 27 decibels. An air-raid siren measures about 140 db at 50-feet distance. An average factory has an overall sound level of about 75 db. The test cell at an aircraft-engine plant measures about 140 db.



EAR-MUFF-TYPE PROTECTORS guard operator against harmful noises. Plant engineer uses this new electronic instrument to measure and analyze area noises accurately

Workers gradually lose their hearing when

Industrial-noise levels usually register from 75 to 120 db. Figure is much higher in some industries.

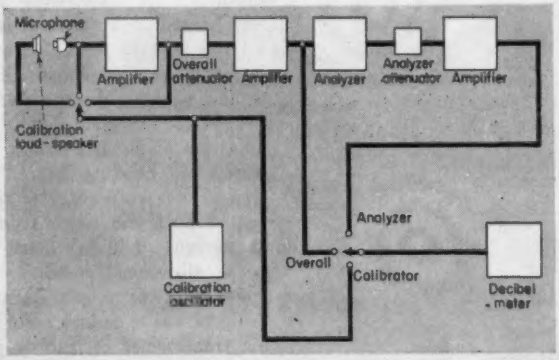
Table, p. 113, shows typical sound-pressure levels and relative energy generated by these levels. We have interpreted these sound-pressure levels in terms of relative energy. From these figures, you can see that a small increase in the decibel level results in a tremendous increase in the effective energy.

It's standard procedure in noise-survey work to measure sound-pressure level in each of several octave bands, besides the overall sound-pressure level.

Octave bands are arbitrary spreads of frequencies (cycles per second) selected so lowest frequency within the band is half the highest in the band. For example, there's a 75 to 150 band, a 150 to 300 band and a 300 to 600-cycle band.

You must measure frequency because the human ear isn't equally sensitive to damage at all frequencies. Octave band of greatest energy concentration must be found so you can evaluate the biological effect of a given environmental noise exposure.

After you make an octave-band analysis and you know the sound-energy distribution in octave bands, you may have to determine energy distribution inside an octave band. This in-



SOUND-PRESSURE LEVEL, octave and narrow band analysis, and field calibrator are all combined in one instrument

Typical sound-pressure levels and sound pressures

Condition	Sound-pressure level, decibels	Relative Energy
Pain threshold	130-140	
Feeling threshold	120	1,000,000,000,000
Airplane, DC-6 (inside)	104	
Very noisy factory	100	10,000,000,000
Subway car	94	
Automobile	92	
Streetcar	90	1,000,000,000
Street corner traffic, large city	75	
Loud radio	74	
Typical office	60	1,000,000
Average living room	40	10,000
Very quiet home	20	100
Audibility threshold	0	1

exposed to a harmful noise day after day

formation is most often needed where there are several noise sources. Then you must determine which source is generating a specific frequency. This measurement is called the narrow-band analysis.

Instrument. Until recently, four separate instruments were needed to obtain sound measurements. In addition to instruments for sound-pressure level, octave and narrow-band analysis, you needed a field calibrator to show if the other three instruments were working OK.

Now, functions of all four are combined into the *Soundscope*. Unit is portable, lightweight, self-contained, simple to operate and has all needed analytical features. MSA engineers believe instrument's widest use will be for industrial-noise control—to combat occupational hearing loss, better known as audio-trauma.

This 20-lb instrument works as (1) a meter to measure overall sound-pressure level (2) an analyzer to measure sound in each of eight octave bands. And it also checks narrower-frequency bands. Electrical and acoustical calibrators are built into the unit.

Uses. Besides its industrial use, this new electronic instrument will help manufacturers to eliminate undesirable sounds from autos, household appliances and other products having moving parts that cause noise. Government agencies can use it to check compliance with anti-noise laws. Engineers can employ it in architectural design work. Scientists, studying human speech, may find it most helpful in their research.

Power plants. You can check noise from motor-generator sets, from steam lines or from furnaces. Coal pulverizers, pumps, turbines, oil burners, draft fans, air compressors, refrigerating compressors and transformers are other sources of potentially harmful noise.

One of your plant's machines can produce sounds of many different frequencies with widely varying intensities. Each frequency band must be studied individually to find the potentially harmful noise source. With narrow-band analyzer you can track down a specific component in a noisy machine.

Sound impulses to be measured fall upon miniature piezoelectric microphone that combines uniform frequency response over a wide dynamic range, high sensitivity, high-acoustic impedance and small size. Impulses go to *Soundscope*, almost free from electrostatic electro-magnetic induction.

Sound is conducted to both a sound-level meter and an analyzer, diagram p 112. In the sound-level meter, impulses are measured over range of 24 to 150 decibels. Signal is measured on an averaging-type meter with a range of 16 db. Overall attenuation can be varied through a range of 110 db in 10-db steps.

Analyzer section consists of an octave-band filter set, controlled by knobs that may be coupled for measuring sound levels in each of several octave bands from 75 to 20,000 cycles. A multiplier dial arrangement, actuating continuously variable high-low band pass filters, permits analysis of noise within any octave band to determine noise peaks.

Following the simple operating instructions, the instrument operator can make a noise analysis by plotting the instrument readings on a graph for comparison with established criterion. Where do you get a criterion?

MSA does not suggest a criterion. Damage risk estimates have been made by authorities on audio-trauma. You can select one of these estimates as a basis of comparison.

After you make a noise analysis for each noise source in a particular plant or area, make a noise-contour map to indicate unsafe areas. You can then direct workers not to enter these areas without adequate hearing protection.

What makes the industrial-noise problem so complex is the human factor. While noise can be measured and analyzed, effect on human hearing is governed by variables of age, physical condition, duration of exposure and other elements.

Occupational hearing loss can be prevented in three basic ways: (1) eliminate noise at source by redesigning machinery and equipment (2) isolate noise by insulation and structures (3) protect individuals who must enter areas shown on the sound-contour map as audio-danger areas.

Design new machinery so that it doesn't generate harmful noise. Alter older machines or methods to reduce noise hazard. For example, you can place a motor on an insulating or dampening pad. Install wood-block flooring instead of cement. Welding is less noisy than riveting, electric tools are generally quieter than pneumatic tools, and belt drives usually create less noise than do gears.

Reflected noise from room boundaries often combines with newly-generated noise to build up loudness. For example, in a powerhouse, noise created by a coal pulverizer "bounces" from the walls and creates a noise buildup or echo. To correct this, soak-up noise with glass-fiber materials or mineral-wool blankets.

Third type of noise protection includes structures such as insulated booths for machine operators. Also scientifically designed devices to be worn in or over the worker's ears.

A new line of over-the-ear cushions was recently introduced by my firm to complement its line of ear-insert devices. These inserts were developed nearly 20 years ago. Over-the-ear cushions can now be equipped with a telephonic headset for communication.

Don't let a forced boiler outage sneak up on you. Pointing up need for maintenance, these tips show . . .

How to keep your

► THE IMPORTANCE of blowoff valves looms large in the average plant engineer's mind when it comes to selection and purchase of boiler-room equipment. But, strange as it may seem, once these valves are in service they're often just taken for granted. Neglected until trouble develops and it's too late to head off an unnecessary boiler outage. The outage may only mean repair or replacement of a blowoff valve. But, it's no secret that blowoff-valve failure has caused some expensive and tragic boiler accidents. Accidents that wouldn't have happened if the blowoff valves had the equally deserved maintenance given, for example, to the boiler-feed pumps.

Good maintenance of blowoff valves means lubrication, packing and inspection at *regular* intervals. All good blowoff valves have lubrication fittings to provide for "in service" maintenance. And, when a boiler is off the line for normal annual overhaul and inspection, the job isn't complete unless it includes disassembly, inspection and repacking of the blowoff valves.

Generally speaking, these valves fall into three categories: (1) hard seat and disk (2) seatless and (3) swing gate. Let's look at them one at a time and see what it takes to keep them in good shape.

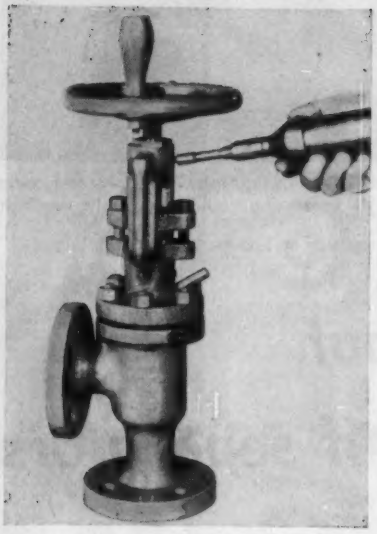
Hard seat and disk valves have fittings to permit lubrication and reduce wear of yoke bushing and valve stem, Fig. 1. At overhaul, inspect the seat and disk hard facing. Lapping in seat and disk will insure a drop-tight valve. (This may also show if the valve leaked prior to overhaul.) If there's moderate indention of the hard facing, you may have to regrind the seat. If the disk is seriously scored or indented, replace it.

Look at the stem, particularly where it passes through the packing. A rough stem means short packing life. Check the wear and fit of stem threads to yoke bushing for snug but smooth operation.

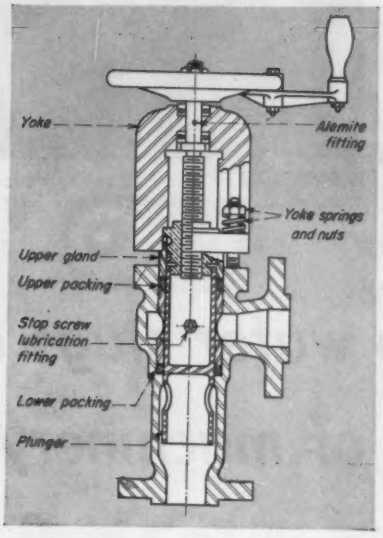
Repack and assemble the valve. Don't pull-up on the gland too hard. New packing is resilient and will better conform to stuffing-box shape after the valve has been used several times and been subjected to operating pressures and temperatures. Then take up a little more on the gland. After this, don't tighten it unless it leaks. Unnecessarily tight glands load the wearing parts, make valves hard to operate and increase packing wear.

Seatless valves have fittings for lubricating the yoke bearing, Fig. 2. Apply lubricant just before blowing down. Squirt some oil on the stem threads, too. If you do it after blowing down, the oil tends to pick up and hold dust which acts as an abrasive the next time you use the valve. It's also a good idea to occasionally slush the plunger. This helps lubricate the upper packing ring and increases its ability to seal.

These valves also have a ball check



1 Lubricate yoke bushing, stem threads on hard seat and disk blowoff valve



2 Seatless valve cross-section shows lubrication points, packing location

3 Swing gate valve has a stem lube fitting. Use a superheat mineral oil

By E E FINSEL, *Mechanical Engineer, Yarnall-Waring Company*

blowoff valves on the line, too

fitting on the stop screw for lubricating the lower packing ring. The stop screw itself has a needle-type check valve to hold boiler pressure.

At overhaul, examine the body bore, particularly packing-ring locations. Surfaces should be smooth to guarantee tight packing seal and to prevent packing damage as the plunger passes during opening and closing. Examine stem and mating threads of the plunger head. If the plunger is worn, you should replace it. Reassembly should include new packing and thorough lubricaton.

Yoke-spring compression nuts keep seatless valve glands tight. Resting on a shoulder of the gland, the yoke presses it firmly against the packing ring. Never put the valve in the closed position when adjusting the yoke nuts. When the valve closes, the plunger head contacts the upper gland and pulls the handwheel tight, compresses the packing, see crosssection, Fig. 2.

Tighten the nuts to compress the springs just enough to seal. It will take a noticeable amount of spring compression, but shouldn't require coil-to-coil tightness. After a valve has been in service and needs coil-to-coil tightness to get a seal, it's a good sign that packing needs attention.

Swing gate or double tightening valves generally have a fitting for lubricating the stem packing, Fig. 3.

Some of these valves have adjustable-stem packing glands similar to those in Fig. 1. Others have built-in springs to compress the packing and external adjustment isn't possible. Both types should have new packing installed during overhaul.

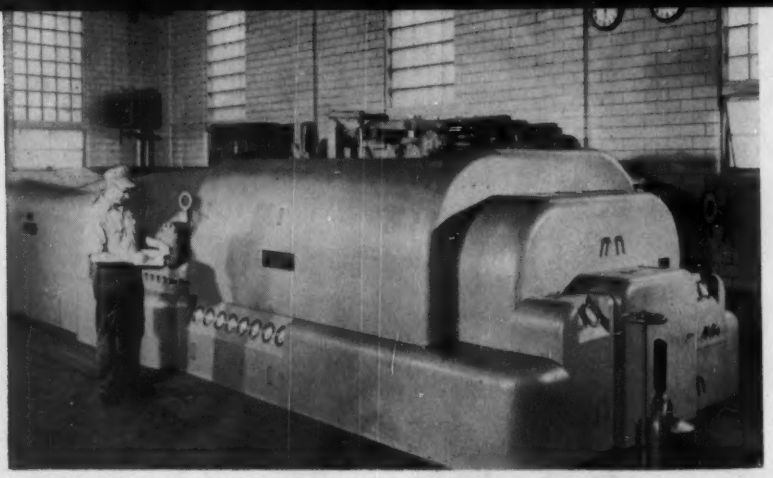
When disassembled, examine the disk or swing gate for scores or other defects. If scoring is mild, the disk can be lapped into the valve cap with a fine grinding compound. This insures a good seal at assembly.

Lubrication won't do much good if you don't use the right type. Blowoff valves are exposed to high temperatures, so pick a good superheat mineral oil having a flash point of not less than 650 F. Another important point: Never use grease of any kind on seatless valves.

Acid-cleaning processes are fairly common with high-pressure boilers. Usual practice is to pump the cleaning acids through the blowoff valves into the boiler and, after cleaning, drain the acids back through the valves. This is rough on blowoff valves. Good valves are usually trimmed with special acid-resistant materials, but if acid cleaning is part of your boiler maintenance program, it's wise to closely examine your blowoff valves for signs of severe corrosion before returning them to use.

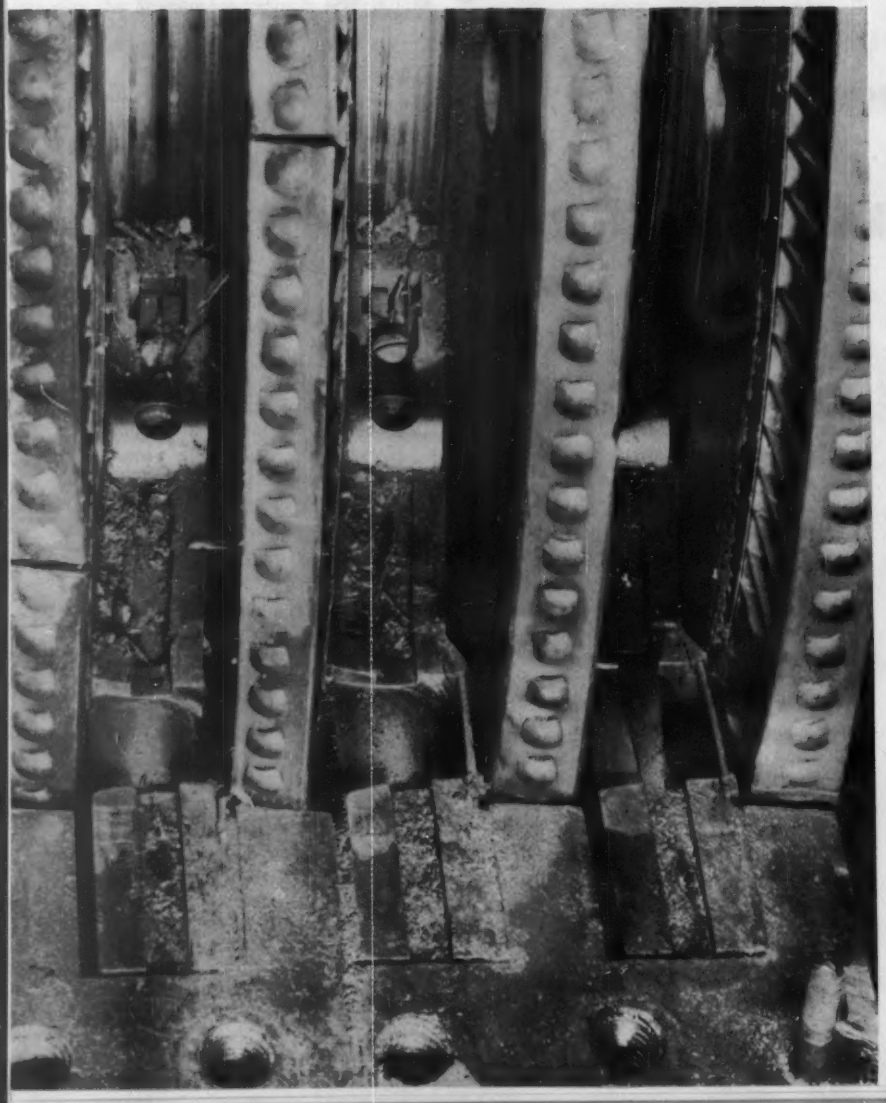
Today's blowoff valves are engineered to give long and satisfactory service. Maintenance based on their importance in keeping your boilers on line, will let them deliver the goods.

By R B DODDS
Worthington Corporation



PRODUCTION in one food-processing plant depends on this 7500-kw condensing double-extraction turbine-generator unit. A water slug could completely wreck it

You can keep water slugs out of machinery if separators



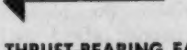
► SLUGS OF WATER have damaged or destroyed a lot of steam-driven machinery. And a good many more units have shut down for inspection after catching a slug. Although the latter weren't damaged, the slugs resulted in downtime, which costs money in any plant.

Investigation of the cause generally points the finger of suspicion at boiler operation since everybody knows how priming or foaming can send water over into the steam header.

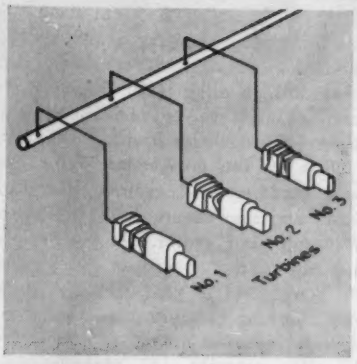
While this is often true, there's another villain lurking in the background. The steam line itself. We generally think of steam lines as means af transmission, but under the right conditions a steam line can generate and deliver a water slug with real knockout power.

Let's see how this happens: All steam lines form condensate, particularly those carrying saturated or low-superheat steam. Under some conditions, lines with supposedly high superheat may have condensate in them.

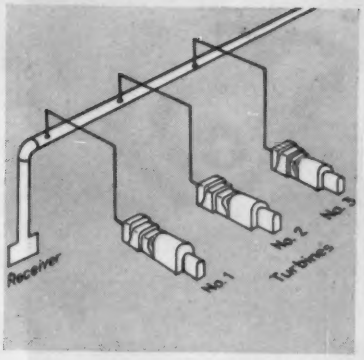
Normally, steam carries the condensate along the periphery of the pipe and it's removed by a steam separator or collected in water legs and trapped out. This works pretty well when steam



THRUST-BEARING FAILURE due to water caused this extensive secondary damage



1 **PERIODIC** boiler priming always damaged No. 1 unit at end of header



2 **WATER LEG** added to header ends problem. Slug goes to the receiver

and traps are . . .

- **In the right places**
- **Big enough to do the job**
- **Kept in good condition**

lines are designed and sized for a relatively constant velocity. Trouble is, many lines are designed for a maximum, but are used at reduced flow. *Examples:* Headers feeding a number of processes or machines that don't always use steam at the same time; generator drives that have large load changes.

Condensate will collect in the bottom of such lines because steam velocity is too low to carry it along. If there's a low spot in the line, or if traps aren't working or properly installed, the condensate stays in the bottom of the line. As more condensate forms its level increases. This reduces effective pipe area and, in turn, increases steam velocity. Steam passing over the water has the same effect as wind on a lake—it first ripples the water, then as velocity increases, forms a wave. When conditions in a steam line are right to form a wave, we have the beginning of a vicious cycle. The wave pushes water ahead of it, makes it higher, reduces effective area and increases steam velocity. Soon the wave fills the pipe and condensate becomes the high-velocity water slug. You don't know it's coming because it forms so quickly and, unfortunately, there's no indication as to when it'll start forming.

Water inertia raises hob with stationary equipment. The force exerted when water changes its direction has knocked ends out of elbows. When it gets into reciprocating machinery, the incompressible water breaks pistons or, if reciprocating inertia forces are high enough, cylinder heads. Tracking down cause of such damage isn't difficult.

In turbines, however, determining cause of wheel-blading or thrust-bearing damage may take a bit of snooping. Let's look at an average turbine with steam entering at 150-fps velocity. The first nozzles expand the steam and increase velocity to 600 fps. Blade velocity is 300 fps, so it's necessary to have steam enter blading at a higher velocity in order to drive blades and produce power from the turbine shaft.

If a water slug replaces the steam entering the nozzles at 150 fps, its velocity isn't increased by expansion so it leaves the nozzle at the same speed. Since blading is moving at 300 fps water can't enter and is carried around in the space between the blading and nozzle ring. Now we start to have real trouble. Due to blade's shape, the water slug becomes a number of small wedges that must be brought up to blade speed. As they are, the wedge shape plus friction of the water produces a heavy force that tends to push the blades away from the nozzle ring. This force causes a bending moment at the blade roots that may break them, and an excessive force on the thrust bearing that may damage it.

Thrust-bearing damage, if not extensive, may be repaired or the thrust bearing replaced fairly easily. But secondary damage, caused by thrust-bearing failure, is a horse of another color.

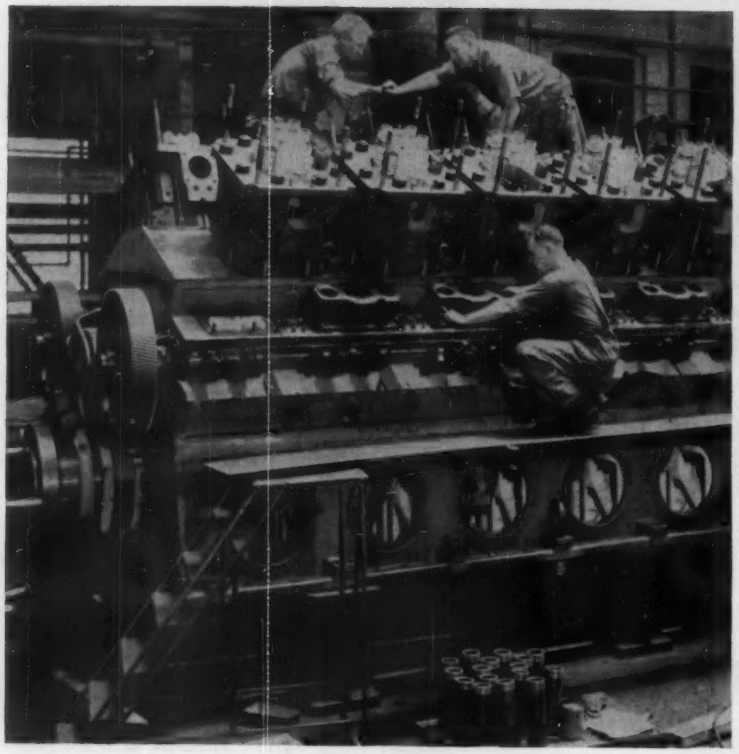
Water slugs, regardless of origin, shouldn't be permitted to reach a machine. Check your steam traps for operation and location. If traps aren't located to remove condensate where it collects, they're helpless once the slug forms and starts through the pipe.

An effective way to set a secondary line of defense is to take advantage of a water slug's inertia. Take steam off to a machine at a right angle from the top of the line—the same as in a separating calorimeter. Let the water continue in a straight line and carry it to a trapped receiver. This will work without a hitch provided (1) receiver capacity is big enough to hold the water before it's removed by the traps and (2) trap capacity is great enough to keep receiver from filling completely.

This scheme eliminated periodic damage to a turbine in a plant that had occasional trouble with boiler priming. A water slug coming through piping as arranged in Fig. 1, always damaged No. 1 machine. The other two weren't affected since the water raced past the tees taking steam off for No. 2 and No. 3 turbines. But then the water had no place to go except into No. 1 unit.

After the piping was changed, Fig. 2, the slug went by No. 1 turbine to the vertical leg where it was collected and trapped out.

Cost of repairs and loss of production caused by a water slug will far exceed cost of extra piping and equipment to prevent it. Separators are available for removing water from steam lines. When you select one, remember that its effectiveness is limited by its capacity and capacity, plus good maintenance, of the traps you use with it.



These sturdy diesels do a better job if you keep them in shape with this . . .

Maintenance check list

► CHECKED your engine recently? Why not run down the items listed here and see how your diesel rates? You can prevent breakdowns if you check these points at regular intervals. The list can help you put your finger on a trouble spot as it applies to almost any diesel. Keep it handy—see that your men use it.

Lubrication. Your diesel engine is valuable. While most engines are rugged, lubrication faults will cause them plenty of trouble. If you have excessive bearing wear or failure, check the following possible causes: (1) corrosive oil (2) contaminated oil (3) incorrect oil viscosity (4) water in oil (5) insufficient oil.

High temperatures. Look for (1) incorrect oil viscosity (2) insufficient oil (3) clogged oil cooler (4) clogged oil lines (5) dirt or sludge in crankcase. Check these religiously for long life.

Crankcase deposits. Guard against (1) high oil temperature (2) low oil temperature (3) water leak in crankcase. Besides these hazards, improper lubrication may cause sticky piston rings, combustion-chamber deposits and loss of power and efficiency in your engine.

Engine parts. Engine parts of an internal-combuston engine are carefully designed and engineered. Each working part is vital to the engine so you should give it careful attention. Follow this maintenance standard for precision parts: (1) handle pistons and cylinders with care to prevent damage (2) check piston and liners for wear periodically (3) check for correct piston clearance (4) check piston cooling system periodically (5) check for worn or weak piston rings (6) allow sufficient ringside and end clearance (7) be sure oil-ring control is effective (8) keep crankcase breather-vent clean (9) maintain proper bearing clearance (10) don't let bearings wear so badly that they fail to align (11) keep intake and exhaust valves maintained and tight (12) don't let bearings overheat.

Gas and fuel oil systems. Extra time and planning will reduce your fuel costs and also ensure full combustion efficiency and power. If your daily log shows that improper combustion or power loss is your trouble, check the following possible causes: (1) incorrect injection timing (2) incorrect injection pressure (3) plugged fuel-oil system (4) fuel leaks (5) sticking fuel nozzles (6) sticking, worn, or leaking inlet and exhaust valves (7) improper or low grade fuel (8) water in fuel. Latter is not uncommon.

Air system. A diesel-engine's air system is vital to efficient performance. Not enough air may result in poor combustion, fuel waste and overall drop in power and operating efficiency.

Poor filtration provides another danger area in the air system. It may cause excessive ring and cylinder wear. Deposits in the combustion chamber often result from poor filtration.

Settings and balance. Proper timing, settings and balance rate top priority for your engine. If you notice improper combustion or lack of power, check immediately for low compression pressure or improper timing. Also check for the following: (1) incorrect injection timing (2) incorrect injection pressure (3) plugged fuel-oil system (4) fuel leaks (5) sticking fuel nozzles (6) sticking, worn, or leaking inlet and exhaust valves (7) improper or low-grade fuel (8) water in fuel.

If improper combustion continues, be sure to check for imbalance of load between cylinders.

Overloading. Properly designed stationary diesel engines can be overloaded to 10% of their full load rating for as long as two hours in any 24-hr period. Keep within these limits.

Warning — regardless of increased emergency demands, etc, you should never make a habit of overloading your engine. Continuous overload operation may result in rings sticking, deposits in combustion chamber, wear, damage, and greatly increased maintenance bills and costly shutdowns.

For best combustion, you should operate your diesel between 75 and 100% load. Extremely low operation can also be harmful, since it often results in improper combustion, and, in turn, causes deposits in the combustion chamber and crankcase of engine.

—Courtesy, Worthington Corporation

Mid-boiling point F	API° gravity																				
	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56
400									24	27	31	35	39	43	47	51	55	59	64	68	73
420								23	27	31	34	38	42	46	51	55	59	63	68	73	78
440							23	27	30	34	38	42	46	50	55	59	63	68	72	77	82
460						22	26	30	33	37	41	45	49	54	58	62	67	72	76	81	
480					22	25	29	33	37	40	45	49	53	57	62	66	71	76	80		
500				21	25	28	32	36	40	44	48	52	56	61	65	70	75	79			
520			20	24	27	31	35	39	43	47	51	55	60	64	69	74	78				
540		19	23	26	30	34	38	42	46	50	54	59	63	68	72	77					
560	18	22	25	29	33	37	40	45	49	53	57	61	66	71	75	80					
580	21	24	28	31	35	39	43	47	51	56	60	64	69	74	79						
600	23	26	30	34	38	42	46	50	54	58	63	67	73	77	81						
620	25	28	32	36	40	44	48	52	57	61	66	70	75	80							
640	27	31	35	39	43	47	51	55	60	64	69	73	78								
660	29	33	37	41	45	49	54	58	62	67	72	76	81								
680	31	35	39	43	48	52	56	60	65	70	74	79									
700	33	37	40	45	50	54	58	63	68	72	77										

CETANE NUMBERS concluded for ordinary petroleum-oil fuels whose API specific gravity and mid-boiling point are known

What your fuels' cetane number means

By **PAUL HOBSON**, *State College, Pa.*

► CETANE NUMBER is a measure of a fuel's readiness to ignite. Higher the cetane number, shorter the delay between start of fuel injection and beginning of combustion in a given engine. ASTM limits on cetane number are 30 minimum for low- and medium-speed engines and 40 for high-speed and dual-fuel engines. Few commercial fuels exceed 60 cetane.

You can find cetane number easily. Starting ease, smoking and knocking are all related to ignition quality.

Starting. The more easily fuel ignites, the more easily a cold engine will start and warm up. Actual minimum cetane requirement for good starting will depend on the design of your engine.

Below 32 F, cetane number will not help much in starting. In such cases, starting aids are usually needed. But a high cetane will still help warm-up once the engine is running.

An engine will start if cylinder temperature, after compression, is above auto-ignition temperature of fuel. Since compression temperature depends on atmospheric temperature, fuel with low auto-ignition temperature helps engine start at lower atmospheric temperature. If fuel's auto-ignition isn't low enough, engine will smoke, especially at light loads when engine temperatures are low.

Knock. Longer the delay in ignition the more fuel in the cylinder when ignition does take place. And, the more fuel igniting at one time, louder the knock. Therefore, higher the cetane, smoother the engine, with some of the following limitations, of course. But this is a good general rule.

Smoke. Too low a cetane number may cause misfire and cold smoke on start-up or at low load. Too high a number may cause black smoke at full load. See *Diesel Smoke*, POWER, Dec 1955.

Engine deposits. If your engine misfires with a low cetane fuel when cold, or smokes from too high a cetane at full load, deposits will form. Otherwise, cetane number has no effect on engine cleanliness.

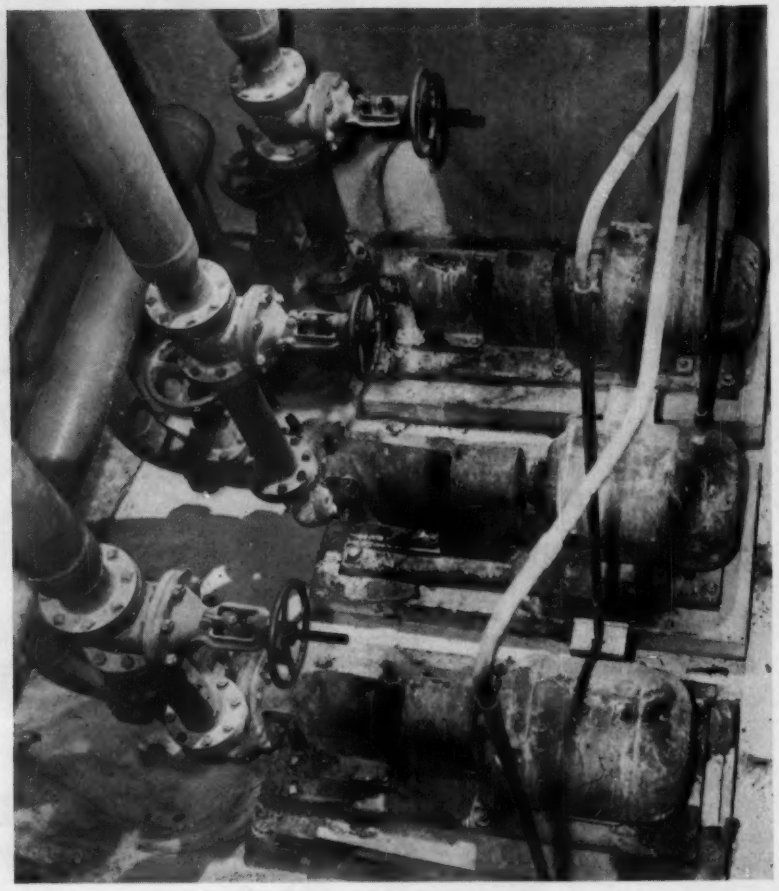
Economy. Because fuels naturally high in cetane have low heat content per gallon, your best economy is usually obtained with the lowest cetane fuel that will burn properly in the engine. If you buy fuel by weight, high cetane fuels tend to have more heat per pound. But these are usually more expensive. So lower cetane fuels may still be your best bet in dollars per horsepower.

High-speed engines. In high-speed truck-type engines there is very little time for combustion. Therefore, high cetane is more important in these engines. Satisfactory range is usually 45 to 50, with 40 as minimum. There's seldom any advantage in exceeding 50.

Dual-fuel engines use very little fuel per stroke and fuel must ignite quickly before it disperses. A fairly high cetane, in the same range used for high-speed engines, is therefore your best bet.

Table, above, gives calculated cetane numbers for ordinary petroleum-oil fuels when API specific gravity and mid-boiling point (50% distillation temperature) are known. It covers most ordinary fuels. Figures are calculated to the nearest whole number from the ASTM formula. Don't use this table for tar, shale or crude (*Continued on page* 198)

By **CHESTER McFARLAND**
De Laval Steam Turine Company



PROCESS PUMPS in a glass-manufacturing plant handle liquid grinding compound. The pumps take their suction from storage tanks and discharge to grinding machines

Partial-shroud impellers improve pumps

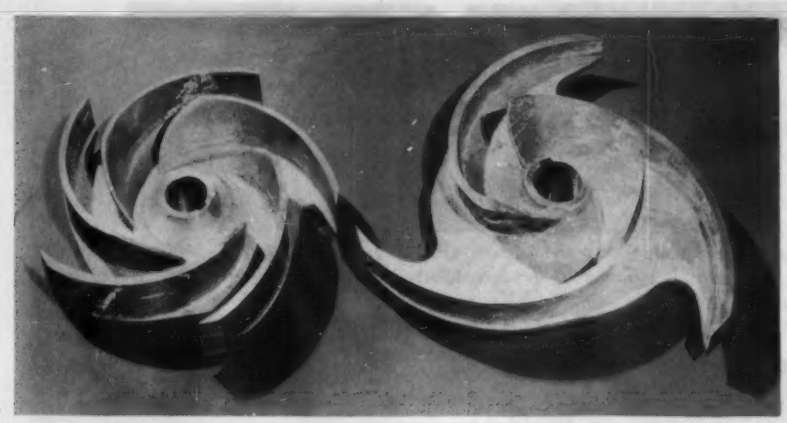
► THE CONSISTENT RESULTS obtained from tests of partial shrouds on centrifugal process pumps reveal that thrust loads can be cut about 35% for operating conditions at or near shutoff. This thrust load reduction in turn reduces possibility of thrust-bearing failure when operation near the shutoff condition is frequent or continuous.

Process pumps particularly may experience this method of operation. Many processes are essentially batch operations, and if these batches are run close enough together, a desirable continuous operation is approached. However, for convenience of operating personnel, this means that pumps used in conjunction with such a system are often allowed to run at shutoff between batches.

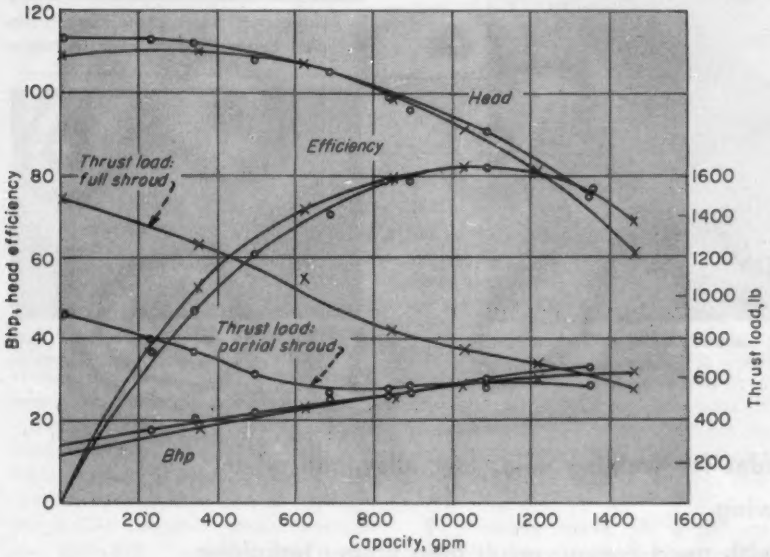
An accumulation of safety factors in selecting the intended operating point will result in operation close to shutoff when the pump is installed. Since most process fluids have not been tested for friction flow characteristics as thoroughly as water, calculations of friction loss are not as accurate as those for water. Estimates of friction loss fo such fluids are often high and affect design head point. Coupled with this, process pumps are production equipment rather than maintenance equipment and further growth of production quotas is considered in selecting the design capacity point. Such a combination can result in a pump selected for one operating point operating at another point by pumping against a partially closed discharge valve to keep its capacity within present requirements.

When a pump is first laid out on the drawing board, the designer has preselected some commonly desired operating point and has calculated the throat, eye and nozzle areas, the impeller vane curvature, width, etc, all in accord with this preselected design point. Shaft strength and bearing loadings are based primarily on this design point with suitable safety factors for infrequent operation at shutoff. In the actual use of the developed pump, deviation from this design point is allowed, provided the deviation is not too great. Various sizes of the same mechanical design are developed to provide a range of heads and capacities falling within acceptable deviation limits of one size or another.

An operating point far beyond the design point will force too much volume through the predetermined areas and result in higher than desirable velocities. This creates poor suction characteristics, noise and cavitation. On the other hand, operation at greatly reduced capacity results in the pump



1 Two single-suction pump impellers with some of the rear shroud area removed. Extensive tests show this removal reduces the shaft thrust load about 35%



2 Performance curves show effect of partial removal of the impeller-shroud area from a typical process pump. Good results are obtained with this scheme

running at or near the shutoff pressure, creating added axial and radial thrust loads. Both of these loads are functions of the pressure and the projected area upon which the pressure acts. The characteristics of a centrifugal pump are such that the pressure increases as capacity decreases, being maximum at the no-flow condition. These loads are present throughout pump's range but are exaggerated at reduced capacity.

There are several methods by which the designer can offset or reduce these forces or their effects. The volute translates the fluid's velocity imparted by the impeller into pressure energy, the pressure gradually increasing from the cut-water or tongue around the volute to the throat through which the fluid escapes. Unbalanced pressures constitute a force in a radial direction causing shaft deflection. Mounting impeller between bearings and increasing shaft diameter gives greater shaft stiffness to resist deflection. A double-volute design can be obtained by locating a second tongue 180 deg around the volute from the first, providing balanced pressures.

Thrust in an axial direction arises from an unbalanced discharge pressure acting in one direction against suction pressure acting in the other. A double-suction impeller with inherent hydraulic balance is used in horizontally split-case pumps and overcomes axial thrust for the most part. What thrust remains is the result of uneven entry of the fluid into two sides of the impeller because of poor piping arrangement or nozzle-casting variation.

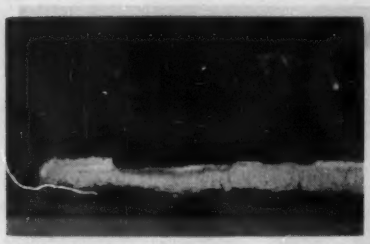
However, the compact, less elaborate and less expensive end-suction design is more practical for both small routine uses and those involving special metallurgies for erosion or corrosion resistance. With this design, the shaft can again be made heavier. But the end-suction arrangement precludes locating the impeller between bearings and usually requires a single-suction impeller with unbalanced axial thrust —in a direction toward the lower-pressure suction side of the impeller.

Remembering that thrust force is essentially some pressure multiplied by the area upon which it acts, some of the force can be eliminated by eliminating some of the area. (The shutoff pressure itself cannot be diminished without changing the design point pressure or altering shape of the pump's characteristic curve.) Fig. 1 shows a single-suction open-type impeller with some of the rear shroud area removed.

Examination of the curves, Fig. 2, reveals the effect of this partial removal of the shroud area. This test, duplicated on several single-suction overhung process-pump designs, establishes the degree of improvement to be expected. In each size tested, axial thrust at shutoff was reduced to approximately 65% of the former value. At full capacity, where the designer's velocities and volumes were more nearly those originally planned, the partial shrouds did not as drastically affect the thrust load which approaches the value that would be obtained with full shrouds.

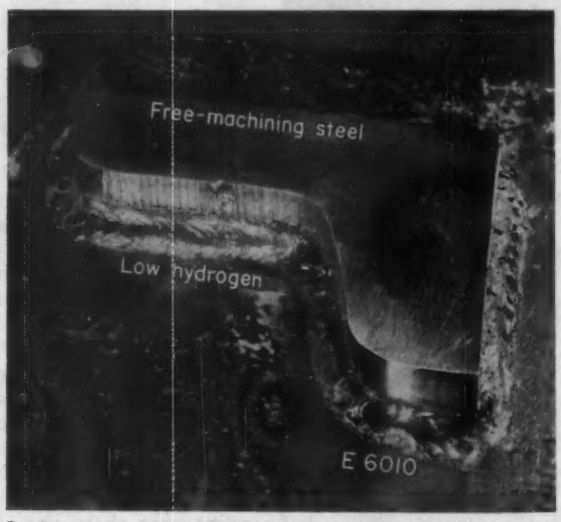
The partial removal of the shroud gives slightly less guidance to the fluid as it leaves the impeller. Efficiency at reduced capacities is lowered slightly. However, process pumps are usually of low power ratings and the difference in increased power due to lowered efficiency is negligible, particularly when compared with the increased reliability and adaptability to process applications in industry today.

1 Excessive moisture in electrode coating caused the porosity in this weld



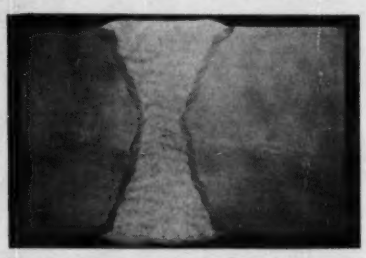
2 Weld made with prime properly-dried electrode (fractured through fillet)

3 This partially completed vertical-up weld shows good groove design



4 Low-hydrogen and E 6010 electrode welds on free-machining steel. Note the difference in porosity between welds

5 Horizontal fillets show smooth rippled beads, flat to slightly convex



6 This cross-section of a butt weld, macro-etched, indicates cleanliness

- **Use of low-hydrogen electrodes for welding mild, low alloy and other problem steels is on the upswing**
- **Strong porosity-free welds with good contour result from proper technique**
- **Here's the know-how needed for best application of this versatile tool**

By D J SCHAEFER, *The Champion Rivet Co*

22 ways to better low-hydrogen welding

► FOLLOW THE SUGGESTIONS below for high-quality welds using both the conventional low-hydrogen electrodes and the recently introduced iron-powder contact type.

1 Care and storage. Most manufacturers now package low-hydrogen electrodes in either 50-lb fiberboard cartons or moisture-proof 50- or 10-lb packages. Store fiberboard cartons in a dry place where effect of exposure to humidity is minimized. For critical work, rebake electrodes at 250 F for one hour just before use.

The moisture-proof containers stay factory-fresh until opened. Rebake unused electrodes as above if exposed for more than eight hours. Figs. 1 and 2 show effect of moisture on low-hydrogen welds.

2 Welding currents. The XX15 electrodes use dc, reverse polarity; XX16 electrodes operate on ac or dc reverse polarity. Low-hydrogen electrodes operate most satisfactorily at the upper end of the specified current range for each diameter. Use the proper amperages to produce a sound porosity-free weld with satisfactory penetration and to obtain the best control of molten metal and slag.

3 Arc length and voltage must be carefully controlled to insure sound well-formed welds. Too long an arc produces improper shielding, may also cause excessive spatter, erratic arc ac-

What is a low-hydrogen electrode?

By definition, low-hydrogen electrodes deposit weld metal with a lower hydrogen content than that laid down by other electrodes. This prevents some of the principal weld defects caused by hydrogen, including "fish eyes," cooling cracks, under-bead cracking (especially in air-hardenable-type steels), erratic arc action. Use of these electrodes is steadily increasing.

Coating used on low-hydrogen electrodes has a high lime content, contains no organic materials and no materials with a high water of crystallization content. Chief source of hydrogen in ordinary electrodes is either in the organic materials or materials high in water of crystallization, or in the combined moisture of the sodium or potassium silicate binder used as the principal bonding agent in most electrode coatings.

Low-hydrogen electrodes are baked, usually at 700 to 900 F. This removes free water and the portion of water of crystallization from the sodium or potassium-silicate binder that would prove a harmful source of hydrogen. Water of crystallization retained is only sufficient to allow sodium or potassium silicate to maintain adequate bonding properties.

The joint American Welding Society-American Society for Testing Materials specification classes low-hydrogen electrodes as XX15 or XX16.

The iron-powder contact electrode is a recent advance. Tentatively classified as XX18 (all position) or XX28 (horizontal and downhand) by the American Welding Society, this electrode contains a medium to high percentage of iron powder in its basic lime covering. It offers the advantages of (1) contact or drag-type technique (2) increased deposition rate from 15 to 35% (3) very easy slag removal (4) smooth, well-rounded bead appearance in the finished weld.

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tion, increased tendency to undercut and produce beads that are too concave. Best operation is with a short arc, just out of contact with the molten pool of metal.

4 Plate materials. Low-hydrogen electrodes are highly satisfactory for mild steel, most low alloy high tensile steels, medium- and high-carbon steels, free machining steels and steel castings.

Fig. 4 shows typical welds on *speed case*, free machining steel, with low-hydrogen and E-6010 electrodes. The low-hydrogen weld is free of porosity; the E-6010 electrode produces excessive pinholing. Low hydrogen is also excellent where a high degree of restraint is involved and on steel parts that are to be galvanized or porcelain enameled. Pipe welding is another application.

5 Groove design. Primarily for butt welding, any of the popular methods of groove preparation may be employed. V-, J- or U-grooves are highly recommended. Root opening should equal the electrode diameter. This insures proper penetration, good tie-in, and eliminates slag entrapment, Fig. 3.

6 Distortion is usually caused by localized heating and is the direct result of non-uniform heating or cooling. If distortion is important, it is best controlled by a carefully worked out welding sequence. Most arc-welding design manuals detail this procedure.

7 Types of welds. XX15 and XX16 electrodes may be used for butt, fillet or lap-type joints.

8 Travel speed depends on the diameter used, position of weld, plate thickness, amperage and to some extent, size of weld. Proper travel speed gives the operator complete control of weld metal and slag, which shouldn't crowd the arc or stretch out too far and thin behind it.

If welder works too slow the metal piles up, slag may be trapped and bead may become convex and irregular. If he works too fast, metal may not be completely covered with slag, undercut is apparent and bead is uneven, thin and too concave.

9 Electrode angle. Low-hydrogen electrodes depend primarily on the mechanical crucible for atmospheric protection. It is best to hold the electrode at 70 to 90 deg to the plate.

On horizontal fillet welds, hold electrode at a 70 to 75 deg angle to the horizontal plate with a trailing angle of 15 to 20 deg. For butt or groove welds, electrode should be perpendicular to the plate with a trailing angle of 15 to 20 deg. In vertical-up welding the electrode should be at right angles to the plate.

Using these angles, electrode gives adequate penetration and produces porosity-free welds with good contour.

10 Position. XX15 and XX16 electrodes in 3/16 in. and smaller diameters may be used in all positions, while the 7/32 in. and larger diameters are restricted to horizontal and downhand welds.

11 Weaving and whipping. Weaving, the term used for side-to-side movement while progressing forward, should be limited to about 2½ times the electrode diameter. Thus, at no time does the electrode have to burn through solidified slag which could result in porosity or slag entrapment.

Whipping, quick back-and-forth movement in line with the travel, should be limited to a short distance to allow the molten rod to solidify in vertical-up or overhead welding. It is not normally used on horizontal fillets.

12 Spatter loss from low-hydrogen electrode is small when used within recommended current range and with proper technique. This loss is less than with any other conventional electrodes, with the possible exception of the newly developed iron-powder contact type.

Best way to control spatter: use a short arc. Spatter tends to increase as the arc lengthens. In multipass work, thoroughly remove spatter before depositing successive beads.

13 Slag control, removal. Slag produced by low-hydrogen electrodes is basic in nature. The composition is similar to that used in basic open-hearth practice which has long produced high-quality steel.

You can readily control slag in all positions, as it is fairly easy to distinguish between the molten slag and molten metal. Pay strict attention to the weld-metal setup rate, which is quite fast. Ignore the slag as it normally clears the arc pool and doesn't interfere with the weld.

Slag is easily removable with hand tools. Thoroughly remove it between

(*Continued on page* 210)

OPERATORS' NOTEBOOK 102

Know your basic controls

What you must know

► YOUR HOT-WATER BOILER must have a safety relief valve to keep the pressure at or below the maximum allowable working pressure. But, until recently, ways of doing this were not clearly understood. Today, the ASME Boiler Code defines the correct procedure in detail. But, in spite of this information, many hot-water jobs are still fouled up, Fig. 1. Is yours fouled? Insurance magazines are filled with reports of life and property loss from needless explosions.

What causes a relief valve to open? The average hot-water boiler is built for maximum working pressure of 30 psi. Relief valve is set for same pressure. So anything that ups boiler pressure to 30 psi causes valve to open, Fig. 3.

Critical demand is placed on the safety relief valve during emergency when it must discharge both high-temperature water and steam, Fig. 4. When relief valve discharges 212 F, sudden drop causes higher temperature water to flash into steam—that's why ASME relief valve is tested and rated on *steam*. Usually valve lifts when heating system can't dissipate heat as fast as it's developed by boiler.

How about low-water conditions? Many hot-water boilers are knocked out by this condition, Fig. 5. Erroneous belief that the pressure-reducing valve used to fill the hot-water system initially will keep boiler and system full causes trouble. Pressure-reducing valve is usually set at 12 to 18 psi while safety relief opens at 30 psi and closes at 26 psi —so pressure reducing valve is ineffective during time relief valve is working. If a hand-fill valve is used, any leak in system can quickly cause a low-water condition.

Minimum basic control you should install on a hot-water boiler is a float-operated low-water fuel cutoff, Fig. 6. Because of higher working pressures of hot-water boiler, low-water cutoff is for working pressures over 30 psi.

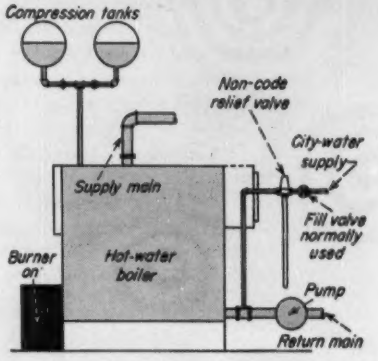
Fig. 7 shows low-water cutoff action in emergency. Lowering boiler water and water in float chamber at same time causes float to drop. That opens electrical circuit and stops automatic burner.

Low-water control, Fig. 8, is about foolproof. But you can't rely 100% on low-water cutoff to stop automatic burner each time there's low water. Reason is that under some conditions low-water cutoff cannot work. Then you must use combination boiler water-feeder and low-water cutoff shown in Figs. 8, 9 and 10.

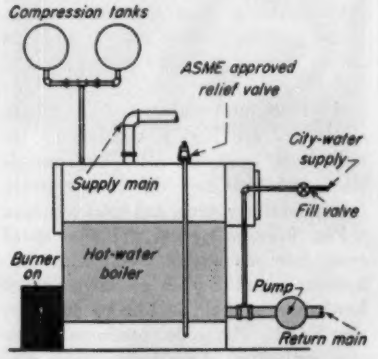
Several kinds of overfiring can occur to make low-water cutoff useless. In such emergencies only way your boiler remains safe is to feed water to boiler as fast as water discharges through the relief valve, Fig. 9.

Large leak or drained boiler causes low-water cutoff switch to stop burner, Fig. 10. How about firing a dry boiler? Fired continuously by a runaway burner and carrying no heating load, this boiler may not explode because it has a modern ASME approved relief valve to protect against over pressure. But the boiler may be ruined because it goes dry, or because it tries to operate as a steam boiler though it isn't hooked up for this service. Check your boiler today.

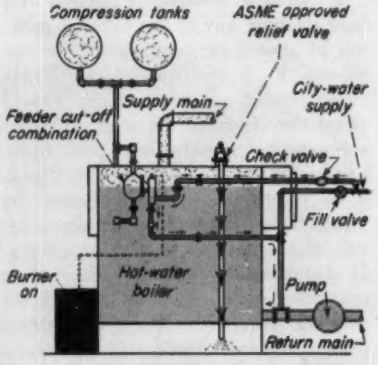
—Courtesy, McDonnell & Miller, Inc, Chicago, Ill.



1 Non-code relief valve—capacity isn't marked, valve's in wrong place, scale in feed line isolates valve from boiler. Don't use relief valve as a reducing valve



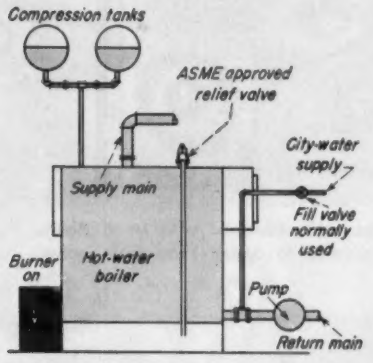
5 Causes of low water: Carelessness in firing dry boiler, drawing hot water; piping, boiler, pump, etc leaks; relief-valve discharge caused by overfiring



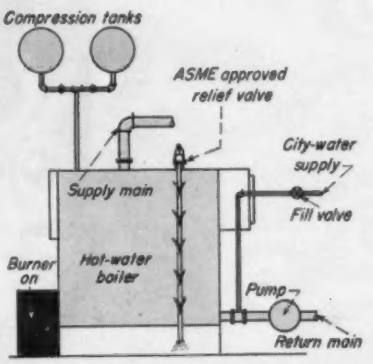
9 Low-water cutoff's useless if boiler's hand fired, fuel feed sticks open, burner's put in 'on' position, zone controls isolate boiler from hot-fuel bed

for hot-water heating boilers

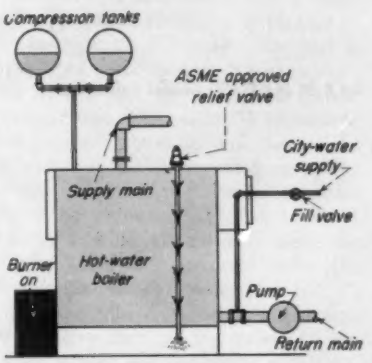
By STEVE ELONKA
Associate Editor



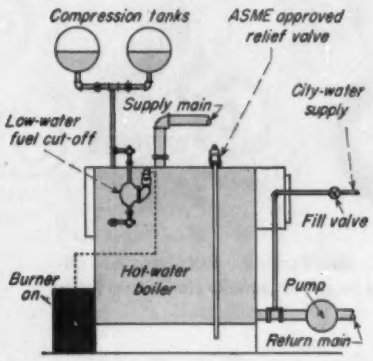
2 Code-approved relief valve has Btu rated capacity, also try-lever for testing. Valve is atop boiler, rated capacity is matched to gross output of boiler



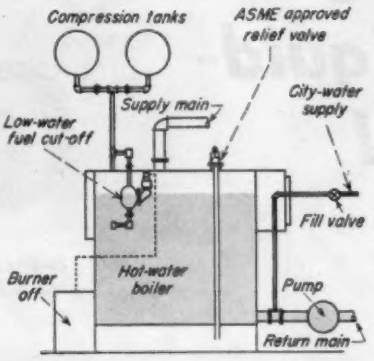
3 Relief valve opens from city-water pressure, hydrostatic test, water-logged or small compression tanks, high-static head or from high pump pressure



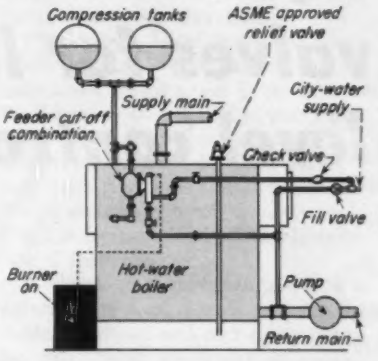
4 Causes of overfiring. Limit control doesn't stop burner, fuel valve fails, burner on manual, residual heat from coal firing, burner is greatly oversized



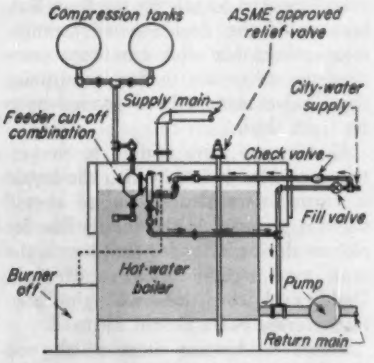
6 Low-water cutoff. Locate control above lowest permissible water level as there's no normal water line in hot-water boiler. Sketch shows safe hookup



7 Remember: attach low-water cutoff that cuts off fuel before water level hits danger point, or attach feeding device with cutoff to steam-water boilers

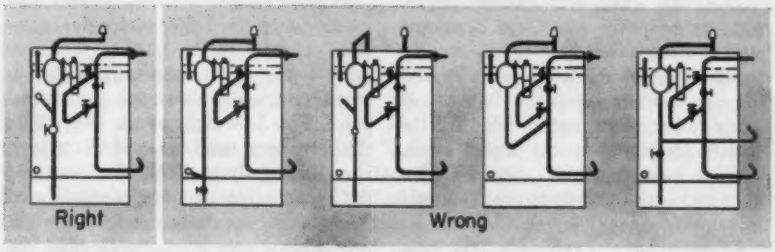


0 Here, water's fed mechanically as fast as relief valve discharges it, burner stops electrically for low water. Setup is best for steam-water boilers



10 Safe hot-water boiler has ASME relief valve to prevent over-pressure, low water cutoff or preferably feeder cutoff combination for maximum safety

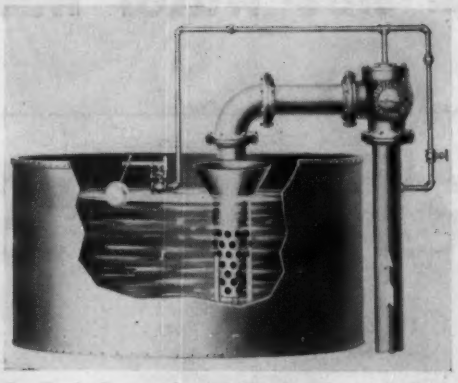
Right way... and common piping errors



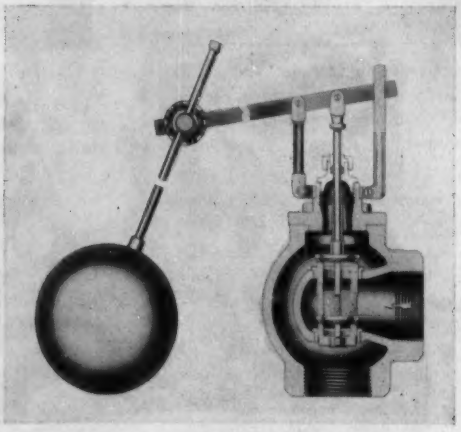
FIRST SKETCH is correct, all others wrong. Check your water feeders and low-water cutouts for these common mistakes. Piping errors shown cause everything from high water in gage glass to low water—regardless of where water is in your boiler. Unless corrected, your boiler will eventually fail. Don't be surprised to find one of these errors in your piping. Install an ASME approved safety valve.

By A M MATTIO, *Klipfel Valves, Inc*

Tips on using float valves for liquid-level control



1 Tank float valve equipped with small float-type pilot valve to actuate the main valve



3 Angle-type direct-acting double-seated all-metal float valve is popular for open tanks

► ON MANY liquid-level control applications all that you need is an inexpensive float valve correctly engineered for the particular service. Here are a number of helpful tips for using these valves.

Selection. You must know several facts to properly select the type and size of float valve best suited for the application. *First*, determine the service. Is it water or other liquid? If liquid other than water, what is the specific gravity? Is the liquid clean, or is it gritty, muddy? *Second*, what inlet and outlet pressures are involved? How much capacity is needed?

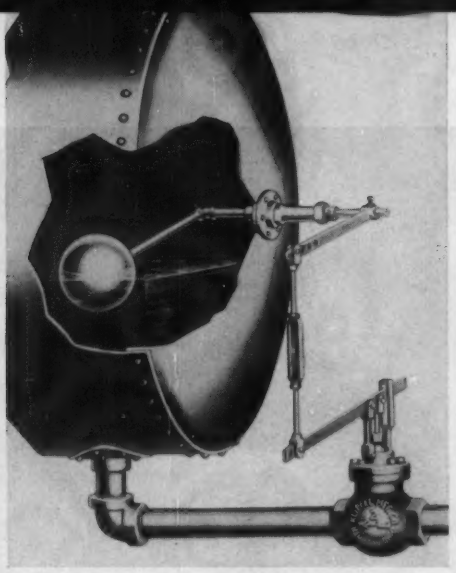
Third, must the valve be tight closing? Only single-seated valves are tight closing, others may permit slight leakage. *Fourth*, what type of end connections are wanted: screwed, standard flanged or extra-heavy flanged? Is the piping arranged to accommodate a globe or angle-pattern valve? If angle, is inlet at side or bottom? *Fifth*, are standard materials suitable for the liquid, or must special materials be used in the valve?

Type. Perhaps the best known and most widely used float valve for automatic control of the level of water or other liquid in an open tank is the direct-acting double-seated all-metal valve, Fig. 3. Weight of the float holds the valve open until the level in the tank rises sufficiently to lift the float, causing the inner valve to move to the closed position. By reversing the lever, weight of the float can be made to hold the valve in the closed position until the level in the tank drops sufficiently to cause the valve to open.

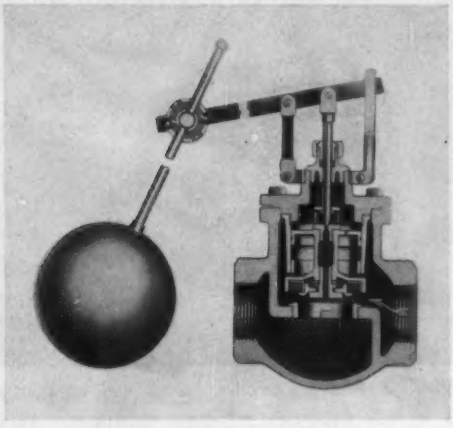
Inner valve. In the design of this valve a double-seated inner valve is used. Incoming fluid acts upward on the top disk and downward on the bottom disk, resulting in a balancing effect. The valve is moved largely by the float. But, because of the double-seated arrangement, where one disk can wear more than the other due to flow conditions, these valves cannot be depended upon for tight closing.

If this type valve is used in connection with a tank from which the liquid is drawn intermittently, and no shutoff valve is provided in the supply line for closure during extended shutdowns, the tank may become filled or overflow. Under such conditions a single-seated tight-closing valve should be used.

Pressure. Another item which you should consider is the pressure of the liquid at the valve inlet. Velocity of the liquid passing through the valve increases as it passes through the seats.



2 A closed tank must be fitted with a special linkage to transmit motion to valve outside



4 Single-seat float valves are popular where moderate amount of leakage is objectionable

Venturi action causes a reduction in pressure in these areas, tending to pull the disks to the seats. The higher the inlet pressure, the greater this pull.

If the inlet pressure is too high, the valve may close suddenly from a nearly closed position and this can cause chatter and water hammer. This is especially true in valves of the larger sizes. A good rule to follow is to allow the inlet pressure to equal 150 divided by size of valve in inches. A 1-in. valve should be limited to 150-psi inlet pressure; a ¾-in. valve to 200 psi; a 2-in. valve to 75 psi; a 10-in. valve to 15 psi.

Leakage. Where slight leakage can be tolerated, the double-seated valve will give years of trouble-free service, mainly because of its rugged, all-metal construction and few moving parts. For those applications where a slight valve leakage is objectionable it is best to use a single-seated float valve as in Fig. 4.

The use of direct-acting single-seated float valves is limited due to the unbalance that occurs between the inlet and outlet pressures. They are recommended only for low-pressure applications. A popular single-seated float valve is the internal-pilot-controlled type. In addition to tight closure, they are adapted to high inlet pressure because of the internal pilot-control mechanism.

As Fig. 4 shows, the inner valve consists of a hollow-bronze piston, somewhat larger in diameter than the seat bore, and carrying the disk holder. The disk is made of rubber composition and may be replaced when worn. It will accommodate itself to grit and wear and still close tightly where a metal-to-metal construction would leak.

The piston slides in a stationary bronze cylinder attached to the cover or body. The pilot port is opened and closed by the end of the stem, which is moved by the float. A pin through the stem at its lower end permits the inner valve to be lifted by the stem. The guide yoke, with the lever and float, can be turned and secured at any angle. The angle and length of float rod can be adjusted at the rosette.

Water from the inlet enters a space above the piston through a small hole in the piston head. While the pilot port is open, this water escapes freely through the hollow post to the outlet. Excess pressure under the piston, in relation to the pressure above it, and the weight of the float, hold the valve open. On closing the pilot port, water pressure above the piston quickly rises to equal and balance the inlet pressure under the piston. Then, inlet pressure above the disk holder closes the valve.

Note that the disk closes in direction of the flow through the valve. In the larger valves, and for higher pressures, the pull of the water in passing through the valve seat may cause the valve to close suddenly from a nearly closed position. Under such conditions a valve should be selected in which the disk closes against flow direction.

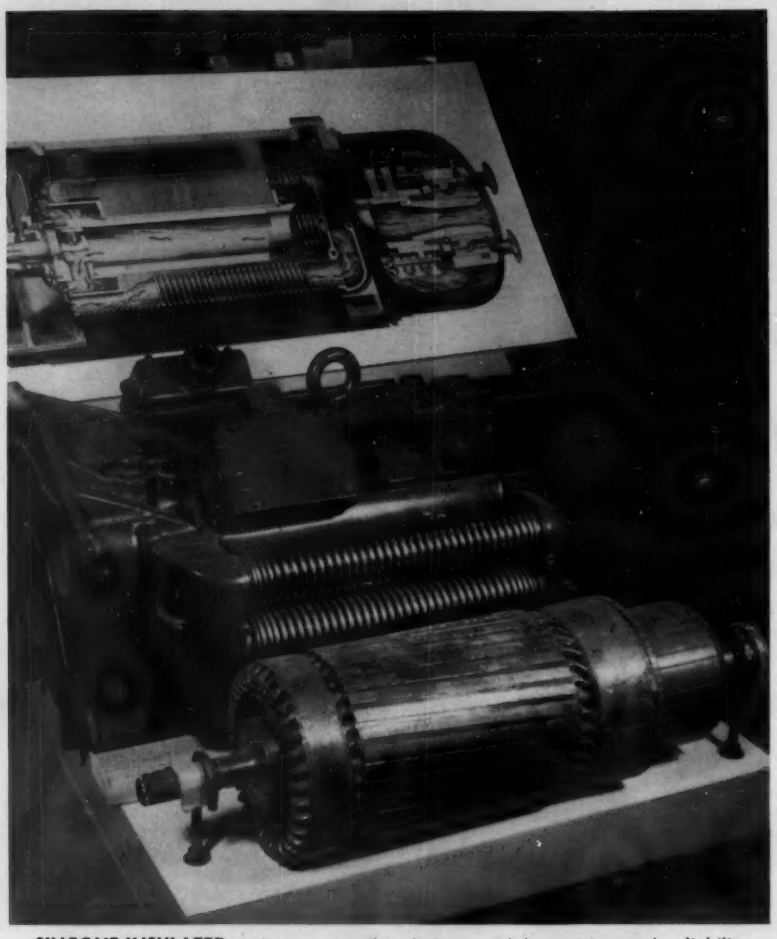
Pilot valve. There are applications where a large liquid capacity is required and where space in the tank is too limited to install a large float valve. Under such conditions a small ½-in. float valve can be utilized to act as a pilot valve to actuate a large main valve that is mounted remotely from the tank. Fig. 1 is an example of such an installation of this type.

A closed-tank operation presents a different problem. The float is placed inside the closed tank and connected to the valve itself by means of special linkage. This linkage, Fig. 4, includes a turn-buckle to permit liquid level adjustment.

Selecting float-valve size to equal the nominal pipe size is a common error. Correct selection of a float-valve size is a thing apart from and only remotely related to the selection of pipe size. If a float valve is too small the fact is obvious as it will not pass the required amount of liquid, and a larger valve is installed. On the other hand, what if the valve is much larger than necessary?

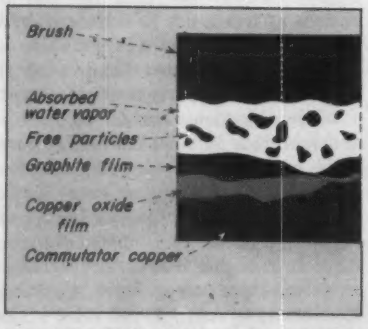
While objections are not so readily apparent, bear in mind that an increase of ½ or 1 inch in valve size may increase capacity 100%, or even 300%. Engineers do not buy pumps, boilers or other equipment that much oversize. Aside from higher first cost of the larger valve, there are definite operating disadvantages. An oversized valve works near its closed position, resulting in

(*Continued on page* 206)



SILICONE-INSULATED units are smaller, lighter and have increased reliability

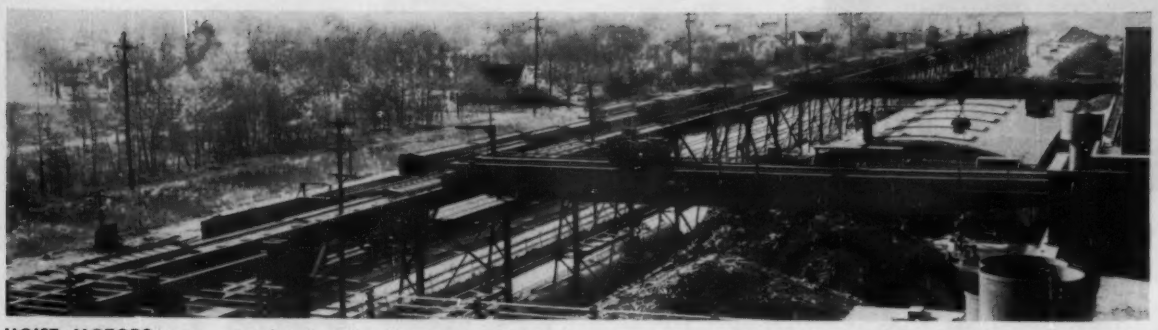
Silicone-insulation vapors can upset commutation



NORMAL FILM between brushes and commutator is made of different layers

► SILICONE INSULATION because of its heat-resistant and moisture-repellent properties is being used to an increasing extent in direct-current industrial motors and generators of all sizes. It's getting to be common practice in some industries to rewind motors with Class H silicone insulation, instead of the original Class A or Class B insulation, to increase life or capacity of the motor. One undesirable effect of some silicone insulating compounds is that vapors rising from the silicone interfere with good commutation. If you've had unexplained commutator trouble after a motor rewind, you would do well to investigate whether silicone compounds have been used in the insulation. Commutation is not affected in open motors, only in totally-enclosed or explosion-proof motors where silicone vapors can become concentrated. And not all silicone compounds give off harmful vapors. Dow Corning Corporation, a manufacturer of silicones, is continuing research to lick commutation problems.

Rapid brush wear and fluctuating contact drop, which at times is very high, result from operation of ordinary carbon or graphite brushes in silicone



HOIST MOTORS were reinsulated with silicone to get continuous-duty service. Old windings had 50% intermittent rating

atmosphere. A line of brushes designed for use in silicone atmosphere has been announced by National Carbon Company. These brushes come in two electrographitic lampblack grades and are said to be suitable for any type of commutating machine with Class H insulation, except those for low-voltage service requiring metal-graphite brushes. The two grades are comparable, except that one has a somewhat better commutating ability. These brushes, according to National Carbon Company, reduce harmful effects of silicone atmosphere to a fractional point. In some applications there may be a shorter brush life than a comparable brush in Class B service.

What happens when silicone vapor upsets commutation can be understood by taking a look at normal commutator film. Components of commutator film are shown in sketch p. 128. Film has four distinct parts: copper oxide, graphite film, loose graphite particles and water vapor. Film is extremely thin, but is very important for good commutation. (Refer to POWER, February 1955, pp 130-133.) Microscopic pieces chipping off the brush furnish raw material for graphite film layer and free particles, and some electrolytic drifting from brush to commutator adds to buildup. The copper of the commutator's surface, plus oxygen from the air, make the copper-oxide layer. The water-vapor layer comes from the surrounding atmosphere. It acts like a lubricant and helps the commutator to slide under the brushes. When atmosphere contains silicone vapors, these mix with water-vapor layer and decompose to form silica. Silica particles act like an abrasive, and rapidly wear down brushes and commutator. Silica particles are non-conducting and increase contact drop.

The fumes from silicone-insulated windings, it has been found, are produced at a variable rate, depending on the type of compound used and the temperature and curing cycle. The emission of fumes does not seem to affect adversely the water-repellent and insulating properties of the silicones. Rate of emission decreases with time, but if temperature rises sharply, even after considerable operation, rate of emission increases suddenly and then slowly drops back to original value.

Exceptional properties of silicone insulation will undoubtedly lead to it being still more widely adopted for dc machines. It is used for slot insulation, coil insulation and laminates as well as insulating varnish. It is silicone varnish that is the chief source of vapors. Silicone-rubber coil insulation is vulcanized by baking it into a solid impervious mass. Silicones are also useful for protecting metal surfaces from atmospheric corrosion and its application to motor and generator frames can be expected to increase. (Refer to POWER, Sept. 1955, p. 118.)

". . . Let's not forget the big, courageous men who made all this hydroelectric power possible . . ."

Plant

Electrical Fact File

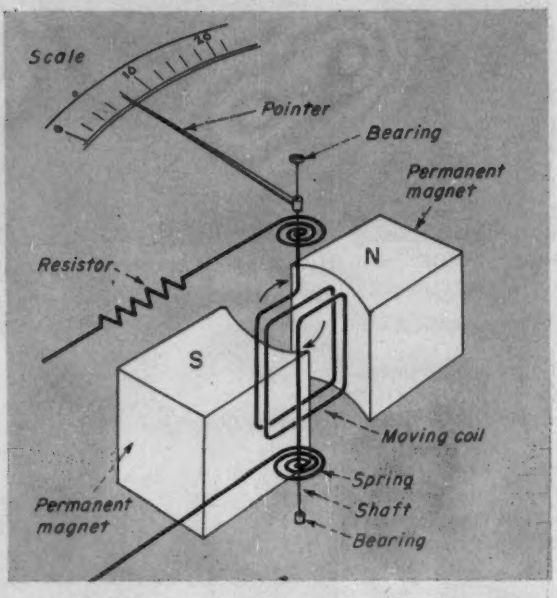
No. 8: INSTRUMENTS

5 basic electrical instruments

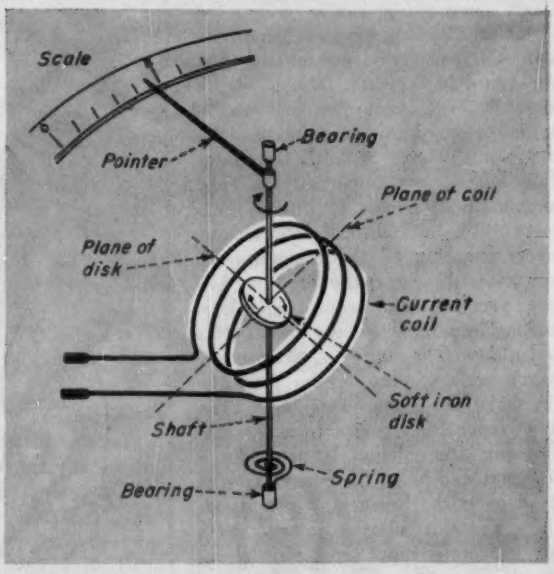
► THERE IS a wide variety of electrical measuring instruments, each designed to do a particular job. The kinds that you will find most useful in industrial plants are all modifications of five fundamental instrument mechanisms. It will be helpful when selecting an instrument to know the way it functions and what type of service it's best suited for. In addition to the basic mechanism, most instruments have damping devices to prevent rapid fluctuation and over-travel of the pointer, and shielding to protect against stray magnetic fields. There also may be internal shunts, multipliers, compensators or other parts needed for a particular application.

Some instruments, not widely used in industrial plants, operate on different principles. One is the hot-wire type which works by thermal expansion. Electronic instruments are in another classification.

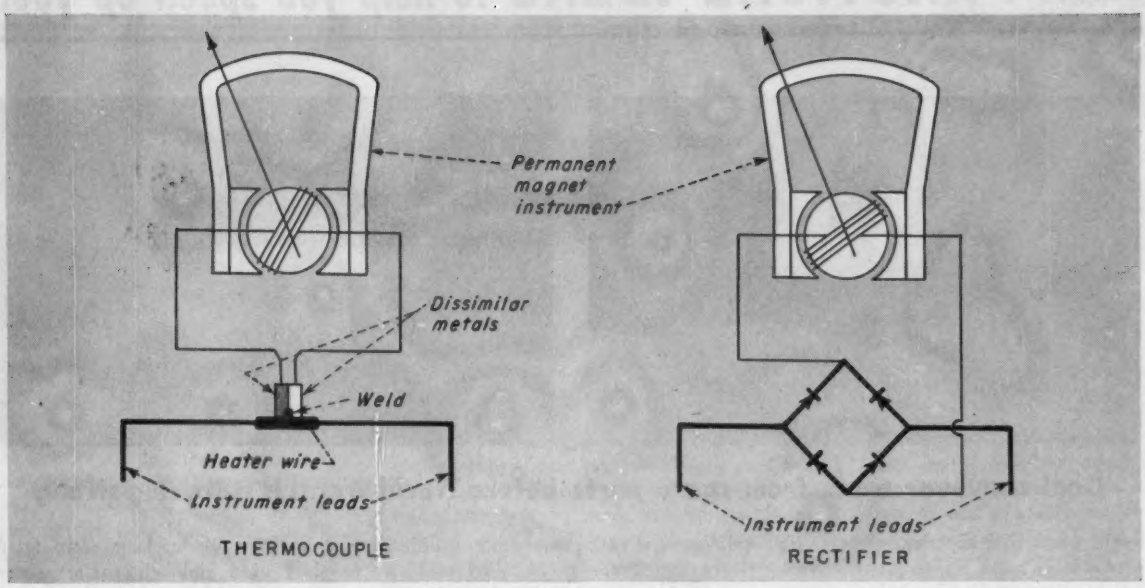
By NORMAN PEACH, *Assistant Editor*



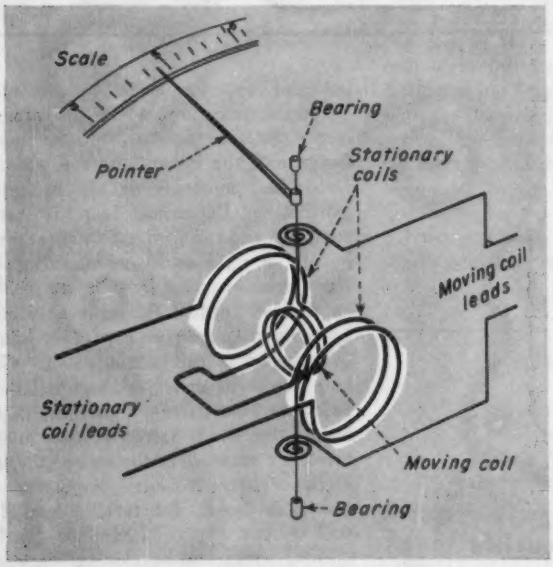
1 **D'ARSONVAL** instrument produces torque by reaction of movable coil carrying small direct current with field produced by permanent magnets. Current is fed into coil through springs. Springs return pointer to zero when torque is not applied. Instrument can be connected in a circuit so coil's small current is proportional to current (ammeter) or voltage (voltmeter). They're widely used for dc.



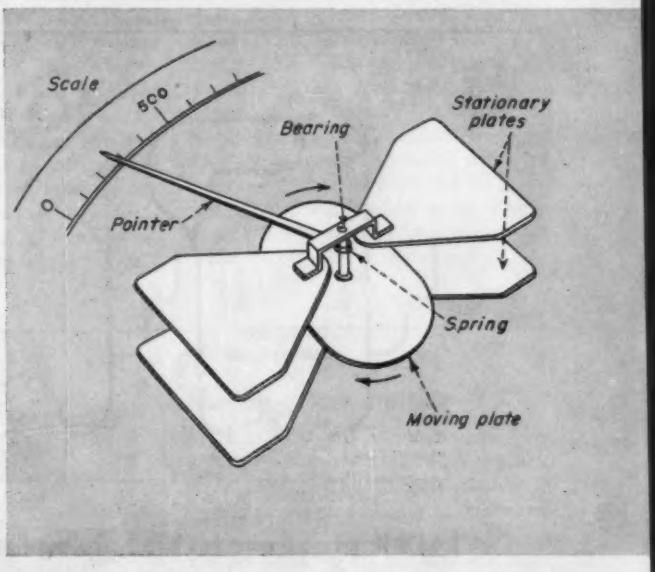
3 **IRON-VANE** principle has many variations for measuring alternating current. Inclined-coil iron-disk instrument is one of simplest. Ac in stationary coil sets up magnetic field. Iron disk turns against tension of the spring to align plane of disk with plane of coil and have magnetic field in disk symmetrical. Since movement is restrained by spring, actual turning will be proportional to current producing the torque. Scale divisions aren't uniform in size.



2 **CONVERSION** instruments measure alternating current with D'Arsonval mechanism by converting ac to dc. Conversion is accomplished by thermocouple or bridge rectifier such as copper oxide type. Higher accuracy is obtained with conversion instruments than with other ac instruments. Where high-frequency currents or currents with irregular wave shapes are to be measured, thermocouple instruments are advantageous. The small emf produced by heating dissimilar metals of the thermocouple yields enough current to drive the instrument. Thermocouple's dc emf is proportional to the heating effect produced by the ac in the resistor and is independent of frequency or wave shape. Rectifier instruments convert ac to dc directly. They're very popular in the form of clamp-on ammeters and wattmeters.

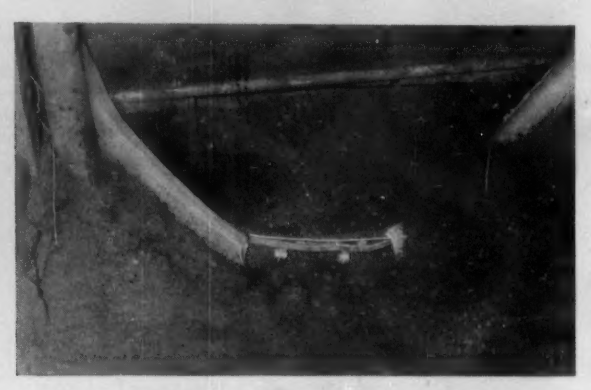


4 **ELECTRODYNAMOMETER** instruments make use of motor principle. They have one movable and two stationary coils carrying current. There's no iron in magnetic circuit. Wattmeters are most common application; movable coil's current is proportional to circuit voltage and stationary coil's current corresponds to circuit current. Other adaptations of instrument measure current, voltage, frequency, power factor, phase angle and capacity in ac and dc circuits.



5 **ELECTROSTATIC** instruments respond to voltage, are used mainly as voltmeters where it is important that current drawn by the instrument is extremely small. Of several types, simplest is vane mechanism, above. Opposite charges on plates attract, tend to pull movable plates concentric with stationary plates against spring's restraining force. Attracting force is proportional to voltage on plates. Instruments, ac and dc, are suited for electronic devices.

Smart PRACTICAL IDEAS *to help you speed up your*

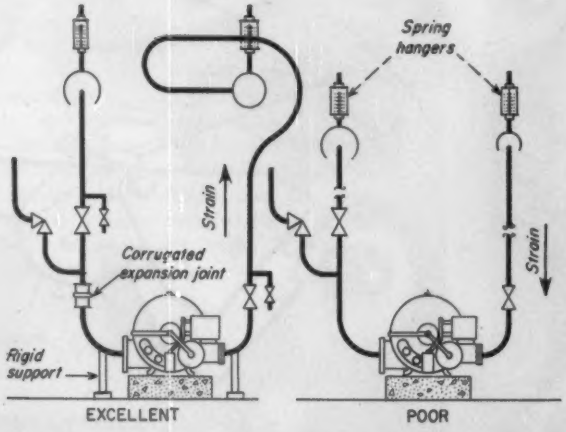


Coal conveyor made from spare parts before World War II is still going strong

Spare parts and experienced help are scarce in isolated plants. At the Granada Mission on the Navajo Indian Reservation in Arizona, we often have to build workable equipment from available material or improvise safeguards to assist unskilled operators. We are situated 40 miles west of Gallup and hundreds of miles from main supply centers. Plant furnishes electricity and steam for a secluded community of 400 people, including a school, hospital, laundry and many other utilities.

We licked our problem by making an efficient pulverized-coal conveyor. It's been in continuous operation since World War II, when machinery was hard to get. Conveyor is made from spare boiler tubes, pieces of 2-in. pipe and standard chain. Four-inch tubes were bent in long curves and welded into lengths to reach from bottom of pulverized-coal pit to top of storage bins over front of boilers, photos. Pieces of 2-in. pipe, ¾ in. long, were fitted to sides of a link-belt chain. These pieces were welded to every fourth link in vertical positions. Openings were cut in the shaped boiler tube to allow pick-up and delivery of fine coal. Motivation is by a 3-hp motor. Chain was threaded into the tube with circular flights extending toward pit's bottom and storage bins. We found that travel of 6 fpm gives the best operation.

H NYE JOSLEYN *Fort Dodge, Iowa*



Let's improve our turbine piping for long life

No part of your steam-turbine installation is more important than a well-designed and well-erected piping system. Shoot for these objectives: (1) Permit pipe expansion without imposing forces and moments on the turbine. (2) Furnish dry steam to turbine inlet at all times and prevent water accumulation in turbine inlet and exhaust lines. Now let's see how to do these.

Second sketch shows poor piping hookup. Is yours like this? Here turbine casing absorbs forces and moments exerted by pipe expansion, thus affects alignment. Turbine misalignment will distort shaft, overheat bearings and cause frequent turbine outage.

First sketch shows an ideal arrangement. Support next to turbine inlet flange and the expansion loop absorb forces and moments set up by pipe expansion. Expansion loop is very compact and efficient. Supports may be of the rigid or spring-loaded type. Any stresses exerted by pipe expansion on turbine exhaust flange is absorbed by the corrugated-type expansion joint.

Properly placed drain valves will help remove moisture accumulation before turbine startup. Pipe must slope toward the drain valves so that moisture isn't trapped in the steam piping. High-velocity moisture impingement may also distort the turbine buckets.

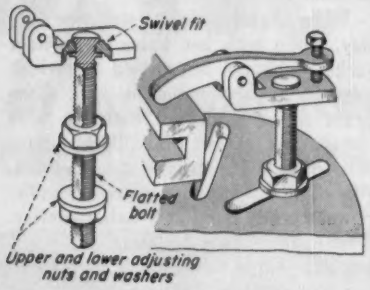
D W ANTONACCI *Pensacola, Fla.*

Did you know . . .

that yard incinerators of an acceptable type must have combustion spaces proportioned and baffle walls arranged so that burning embers won't be discharged from the stack? That's right.

operation and maintenance jobs

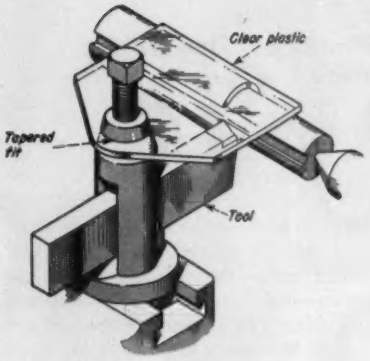
STEVE ELONKA, *Associate Editor*



Quick-action finger clamp

When you have to do light clamping on a drill press or other machine tool, here's a shop-made clamp that'll adjust itself to your work. It's quick acting, can be positioned at will, needs no blocking and saves plenty of time.

C H WILLEY *Penacook, N. H.*



Chip guard for lathe

When interrupted cuts are taken with a lathe tool, chips flying from tool are a hazard to operator's eyes. Chips are usually hot enough to burn your skin. Short brittle chips also fly off the tool tip when machining tough materials such as annealed tool steels and the like. These jobs are dangerous.

Pillar-type tool post lends itself to fitting a chip guard, sketch. Guard is small sheet of transparent plastic, fixed to taper portion of tool post. Hole in plastic is tapered to suit taper of tool post. Neat fit assures locking effect. When not needed, guard can be removed and unlocked by twisting.

Because guard is close to cutting tool tip, you can make it fairly small. Then it won't slow down the operator.

C T BOWER *London, Eng.*

What would you have done?

I was an engineering inspector for an insurance firm that insured a horizontal tubular boiler in a mill-work plant. Boiler was fired by chips and sawdust from a cyclone collector, plus hand firing of edgings and blocks. While inspecting a corliss engine, I got a shot of hot water on the back of my neck. Turning around, I saw the head gasket on the feedwater heater squirting. Operating engineer shut down the engine, saying that the boiler had been taking water slowly because her internal feed pipe was blocked.

Checking the boiler, I found water in the bottom of the glass. Firebox, which was packed full of scrap wood, had a roaring fire. We couldn't pull the fire as there was a chip hopper only eight feet from the boiler's front. Trying to haul the fire would probably have set the plant on fire. Safety valve set at 75 psi started blowing, thus losing more water. We figured water would be below the top row of tubes before fire burned out and setting cooled.

I threw a few shovels of sawdust on the floor in front of the ashpit. Then I lay on my back while the operator held a scoop shovel over my face. I reached into the ashpit and disconnected the horizontal nipple from the water-glass blowdown pipe. Then I unscrewed the blowdown pipe from the water column and connected a garden hose from a sink faucet to the water-glass blowdown. As plant's water pressure was about 25 psi above the boiler pressure, we could feed some water to the boiler through the water glass.

After about one hour, we shut off the cold water because we had gained a couple of inches in the glass. Also, pressure had dropped so safety valve was no longer blowing. Fire had burned about three quarters down. We raked it forward a little so some draft went through the back end of grates and not through the fuel bed. This also helped. Boiler wasn't equipped with ashpit doors, all draft regulation being by stack damper. This is the only time I know of that anyone fed a boiler through the water glass in an emergency. What would *you* have done?

F L GILLMOR *Albany, N. Y.*

Handy screw holder

When you have to insert a small bolt, screw or rivet in a hard-to-get-at place, make one of the gadgets shown in sketch. They are simple to make, always handy. Time spent to make one will be made up on the first few jobs.

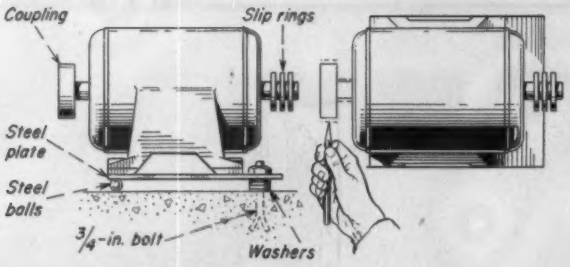
Bottom one is made by twisting and shaping wire as shown. You can make it fit any size screw when you need it. There's always wire around the average shop for twisting into this handy holder.

C H WILLEY *Penacook, N. H.*

Turn page for more Practical Ideas ►

More PRACTICAL IDEAS

Begins on page 132



Here's your trick of the month

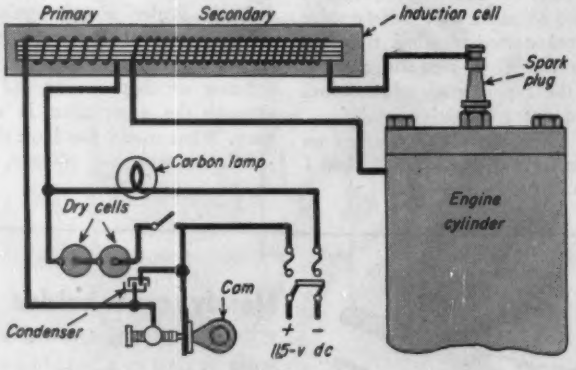
We burned out the rotor on a 30-hp, 2950-rpm, wound-rotor induction motor. After rewinding, vibration was pretty bad because of mechanical unbalance. We balanced rotor statically on rolling knife edges but vibration wasn't cured. Nearest dynamic-balancing machine was about 1000 miles away in a foreign country and rail transport would take six weeks.

We had to try dynamic balancing ourselves. Sketch shows simple trick that did job. First we mounted motor on a piece of ½-in.-thick steel plate. Then one end of plate was supported on two ¾-in.-diameter steel balls. Other end was pivoted on a ¾-in. steel bolt, grouted into concrete floor. Unbalance caused motor to oscillate about pivot. Pencil held against coupling marked the point of maximum swing.

Due to inertia of mass, mark made on coupling was in different position when rotation was reversed. We took mean of two positions marked as point where rotor was heavy. Then we added weight at a point diametrically opposite until oscillation was reduced.

After improving balance at one end, we turned motor end-for-end on the plate. Same routine was carried out, this time marking a slip ring. Balance weights were fixed to the ventilating-fan shroud at one end of the rotor and to the winding support ring at the other end. After several adjustments the motor was as free from vibration as any similar motor in our plant. No doubt this method has many other uses.

G F Browne *Salisbury, Rhodesia*



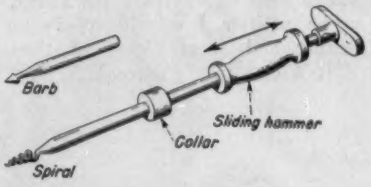
Emergency power for gas-engine ignition

We had to pump out the "sag" in a section of railroad track that underpassed a mainline section. Underpass was on a grade level that lay a few inches lower than the nearby river and thus had seepage. Well in track-side area collected the seepage and acted as a storage sump. Our roving mechanic stopped in four times a day to operate the single-cylinder gas engine housed in the shack.

Typical of early-type ignition systems on single-cylinder engines was the dry-cell-operated induction coil. Coil operated as a "make-and-break" circuit through contact with a cam, sketch. Dry cells naturally started deteriorating from moment they were installed. Resulting loss of voltage reduced intensity of spark. That made cold-weather starting tough.

When engine failed to start one cold day, (even with hot water in cylinder jacket) operator improvised to furnish current for the induction coil. Diagram shows how dead batteries were cut out of circuit. Auxiliary circuit was wired to supply a controlled quantity of direct current, with 16-candlepower carbon lamp as a ballast device. New power supply did away with starting delays and the engine's power output was greatly increased. Only undesirable feature was more rapid wear of spark-plug points inside cylinder.

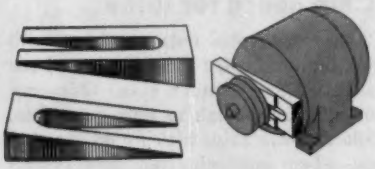
P C Ziemke *Oak Ridge, Tenn.*



Handy packing pullers

This may not be a new idea to some Power readers, but I use a set of tools, sketch, in my plant. I made them years ago and find them very useful. Use on stuffing boxes of pumps, engines, motorboat shafting—anywhere that ring packing is compressed around a shaft and held by a packing gland. You should make the two types of rods shown—one with a spiral corkscrew end, other with a straight barb end.

C H Willey *Penacook, N. H.*



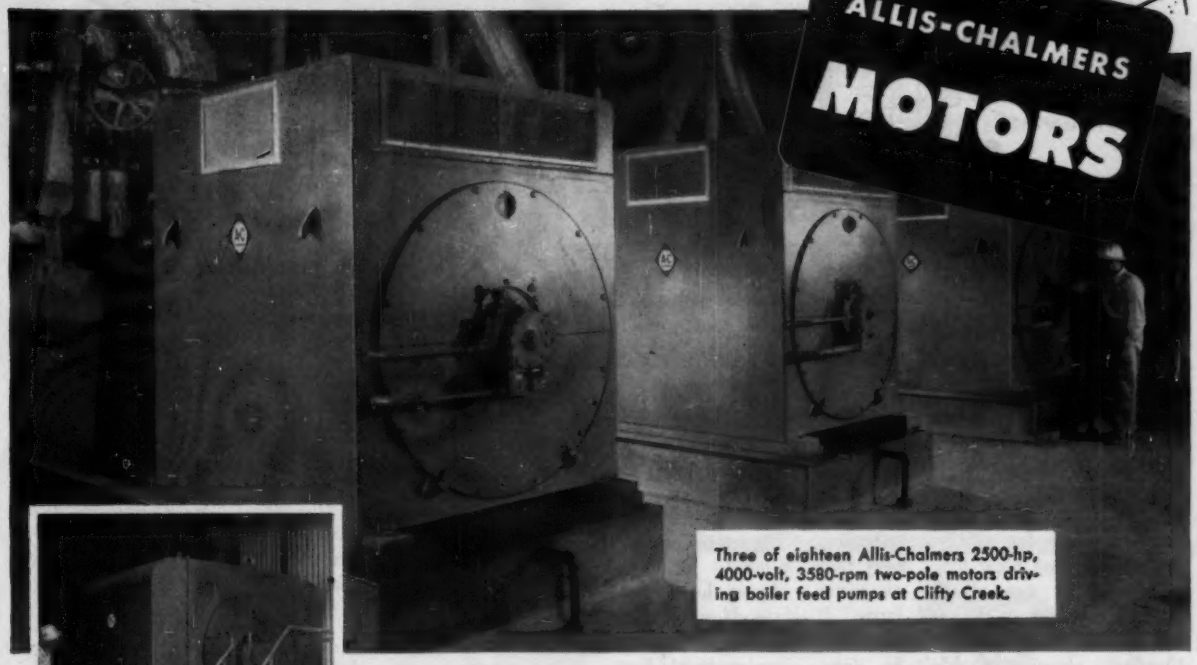
U-shaped wedges are convenient tools

Your shop should have a few sets of these U-shaped wedges. Make them of good steel in different sizes. They have many uses, are especially good for removing pulleys, frozen bolts, etc. Apply wedging action evenly from both sides. Keep a set handy in your tool kit. Sizes naturally depend on service.

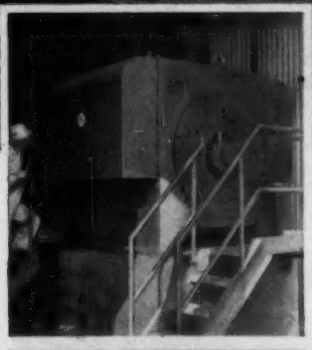
C H Willey *Penacook, N. H.*

Turn page for more Practical Ideas ▶

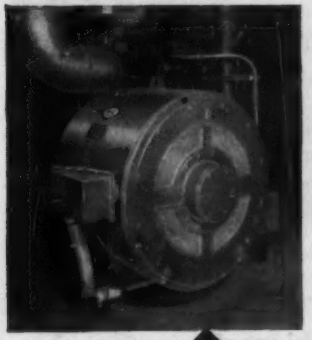
Furnishing Major Auxiliary Drive Power at Indiana-Kentucky Electric Corporation's Clifty Creek Plant



Three of eighteen Allis-Chalmers 2500-hp, 4000-volt, 3580-rpm two-pole motors driving boiler feed pumps at Clifty Creek.



Rooftop installation of Allis-Chalmers 1500-hp, 4000-volt, 1185-rpm weather-protected motors. This is one of twelve Allis-Chalmers motors giving dependable service driving forced-draft fans at this modern new plant.



Allis-Chalmers 250-hp flange-mounted motor driving plant air compressor. This unusually economical mounting method for such a large motor can be attributed to Allis-Chalmers experience in motor applications throughout the electric power industry.

A wide variety of Allis-Chalmers motors furnish most of the major auxiliary drive power at Clifty Creek Plant near Madison, Indiana. Allis-Chalmers motors are driving plant air compressors, coal handling equipment, forced-draft fans, boiler feed pumps and many other pumps.

The Allis-Chalmers motors at this Indiana-Kentucky Electric Corporation installation are just a few of the complete line of motors Allis-Chalmers builds for power plant service. Contact the Allis-Chalmers district office in your area, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for complete information. A-4956

Now, You Can Get Even Greater Winding Protection with SILCO-FLEX

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A-C ALLIS-CHALMERS

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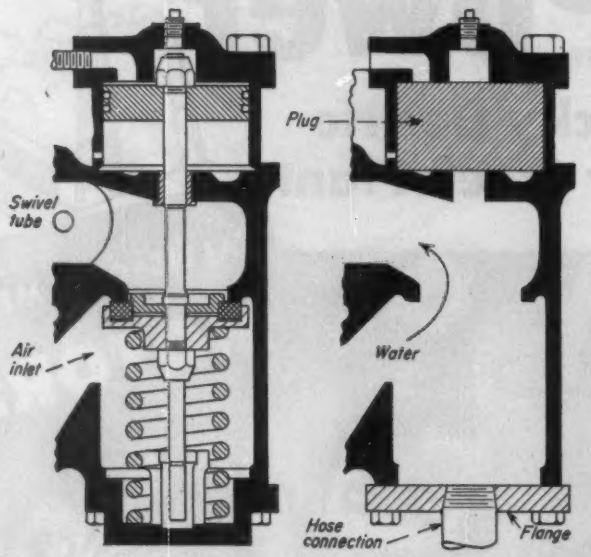
More PRACTICAL IDEAS

Begins on page 132



Here's how we wash tubes with air puff blowers

Our ship has two sinuous header boilers of 53,500 lb steam per hr, 740 psi, 850-F superheat.

About 500 barrels of bunker C per day is burned in the two boilers. We had trouble keeping superheater tubes clean enough for efficient operation, even though we blew tubes every four hours. Every two months we water washed a boiler with hand lance. It was time consuming, dirty, wet and thorough cleaning couldn't be done.

Each boiler has air-puff soot blowers. Having washed boilers with steam soot blowers I wondered why not wash with air puff blowers?

First, I removed top cap, bottom cap, valve spring, valve piston and rod.

I plugged the piston cylinder, sketch, with same OD stock and length as the cylinder. Pipe flange was fitted for bottom cap, bored to fit a 2½-in. hose connection; only two pieces needed.

After installing plug in cylinder, I replaced top cap as shown.

Only one hose connection is needed if more than one soot blower is to be used for washing. Bottom cap can be replaced on all soot blowers except one. Water will flow to the main air pipe and then to all heads. If ball checks are not installed on scavenging air lines, you'll have to install blanks in these lines. Install in lines of heads used for washing purposes, or install on heads of lines not being used for washing. If all heads are used, you don't need to install blanks.

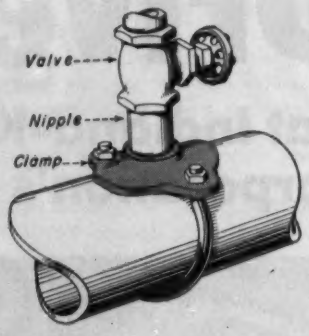
Air-supply line to master controller usually has a tee after air-inlet valve to master controller. With all manually-operated valves closed, remove test plug tee. Connect temporary air to this tee from main air compressor. An air hose is a convenient way to make this connection. Air will then be supplied to jacking engine on each soot blower head, causing element to rotate. If water pressure is higher than air pressure, install a check valve in temporary air line.

I have been washing boilers in this way for a year with very good results. I've found that when water leaving firebox is clean, you can use it intermittently to keep slag wet. Thus, less water is needed for job. Keep water at about 40 psi, between 80 or 90 F. I wash only superheater tubes this way. Our generating tubes stay clean. Hot water will cause too much moisture to accumulate on generating tubes above superheater tubes.

When taking soot blower heads, pistons, rings, valves, rods and springs apart, check for wear or breakage. If soot-blower heads are accessible, one man can change a single head in 20 minutes. On our ship three soot blowers are fitted in the superheater bank, so only three heads are changed over. Depending on water volume available, you can use as many heads as desired.

After washing, I blow tubes in the conventional way before firing boiler. This blows off loose slag before it has a chance to adhere to tube surfaces.

A F Baptiste *Brooklyn, N. Y.*



Here's a better leak clamp

The article, "How to plug bad leaks," p 144, Feb Power, is very interesting. Here's a simpler way, using standard fittings, that's permanent and less messy. Service clamp has a tapped hole, sketch, very similar to clamp shown in Feb article. While fitting the clamp and pulling it tight, leave valve, fitted to this hole, open. Air, water, steam or gas under pressure goes out the open valve. This valve can be fitted with a pipe or hose to get the discharge safely away. When the clamp is in place, close the valve. This works for any size of line and for as high pressures as can be handled safely by fitting and clamp. It's a very handy rig.

E A Roberts *Carlsbad, N. M.*

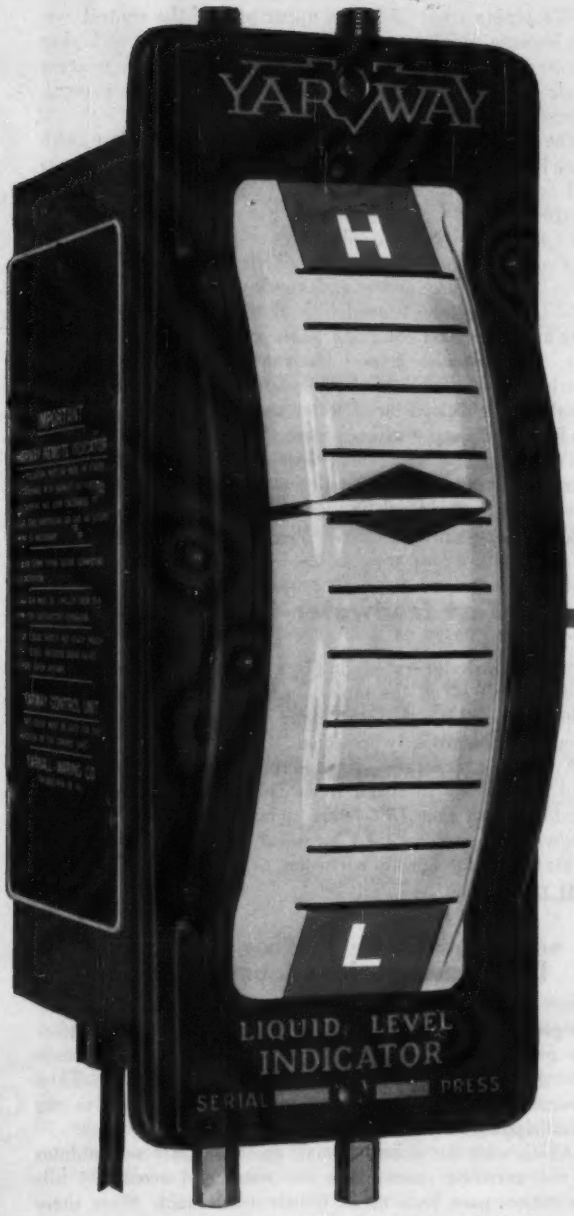
Baby needs new shoes?

Did you ever get a check from Power? It's easy. Just send me your latest practical improvements. Add sketches, photos, or both. You'll receive a check for each idea I accept. Some readers get these checks every month. Don't let your kid down this winter. Send me your ideas today.—*Steve Elonka.*

My biggest boner

Please turn to page 206

this is "life insurance" for boilers



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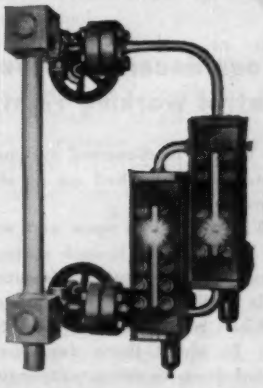
Yarway Remote Liquid Level Indicator. Write for Yarway Bulletin WG-1824.



Yarway Flat Glass Water Gage with Type "M" Illuminators. Write for Yarway Bulletin WG-1812.

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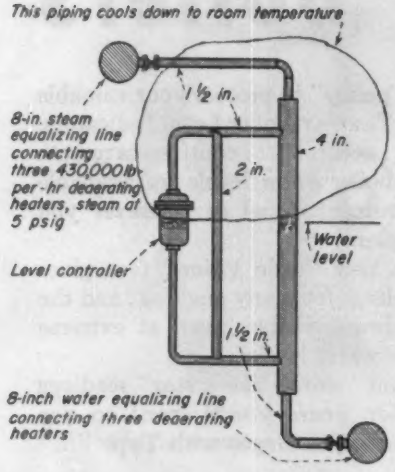
YARWAY steam plant equipment

Have a PLANT PROBLEM? Tap the


This piping cools down to room temperature
1½ in.
8-in. steam equalizing line connecting three 430,000-lb-per-hr deaerating heaters, steam at 5 psig
4 in.
2 in.
Water level
Level controller
1½ in.
8-inch water equalizing line connecting three deaerating heaters

The question

Is our deaerator level control working right?

We have a level-control system on our deaerating heater that's hooked up as shown in the sketch above.

With all valves open and with 5-psig steam in the header, the 1½-inch steam piping cools down to room temperature. Dismantling the piping reveals that no pipes are plugged.

When returned to service, the entire system is hot. In about three days the piping has again cooled down to room temperature. The level control functions normally. How could this happen?

—*JWG*

The answers

Gases cool pipe but they needn't interfere with right operation

JWG's piping cools off in the upper part of the control system because it fills up with a non-condensable gas of higher density than the steam above it. Gas is probably a mixture of air and carbon dioxide. But other gases may be present, depending on the water treatment *JWG* uses.

The presence of these gases should not interfere with good level control. At worst, level in the deaerating heaters will only be a fraction of an inch higher than that in the controller. But deaerators should get a performance check. Most of the non-condensable gases should be vented at the vent condensers, thus leaving very little gas to collect. These gases could cause boiler and condensate-system corrosion.

JWG should take a good look at the deaerating trays. If they aren't in good condition gases won't be liberated properly. He must also inspect the vents to see if any dirt is restricting free venting of gases from the vent condensers. If tubes aren't clean, or if water entering vent condenser is too hot, not all vapor will condense.

To keep controller piping free of gases, a combination thermostatic and float-vent valve can be installed just above the highest control level.

F SHYMANSKI — *New Westminster, Canada*

Test feedwater for oxygen

While some designers might place a level controller on the lines instead of on the tank in order to save money, most operators would install two more controllers so that each tank would be properly protected.

Even on a deaerator, three days sounds a little fast to trap enough air to reach room temperature. Therefore, I would suggest that *JWG* start running oxygen tests on his feedwater or at least take a careful look at the water level in his boilers for signs of corrosion.

H HOLCOMBE — *Los Alamos, N. M.*

Don't change level-control system

Simple power-plant physics explains *JWG's* puzzler. After the piping is reassembled, water fills the lower and steam fills the upper space until pressures are equalized. Then condensation begins on pipe walls and flows down to the equalizing main.

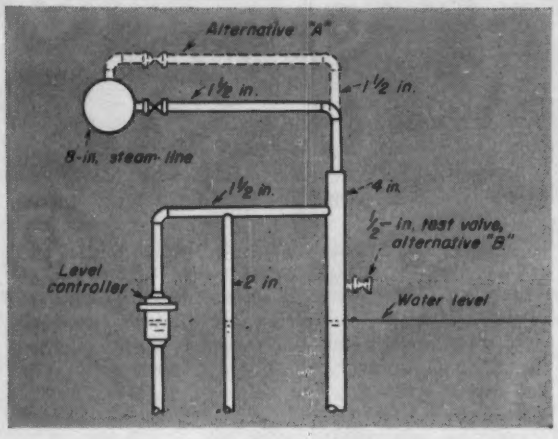
Along with the steam, a small amount of air accumulates in the unvented space above the water and eventually fills the entire space back to the 8-inch steam main. Since there is no steam circulation the pipe cools.

JWG says the level control functions normally. I would advise him to leave well enough alone. It's not often we can utilize a self-replenishing live air column to transmit useful pressure variations.

J A GRAHAM — *Pittsburgh, Pa.*

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*

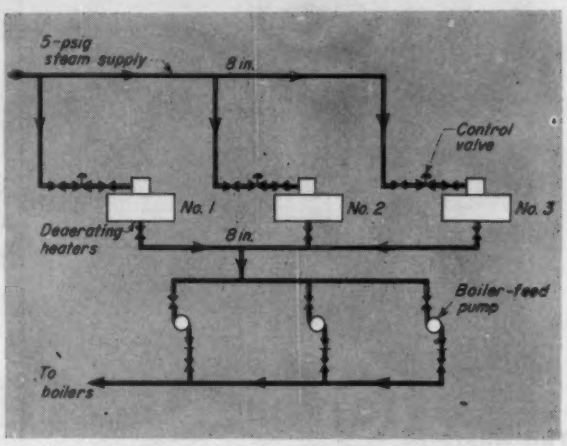


Air builds up over water level

Reason why *JWG's* level-control system cools down to room temperature: There is a slow accumulation of air over the water level. This air slowly makes its way from the 8-inch steam line. Since steam is lighter than air (specific gravity about 0.62), air in the steam line flows through the 1½-inch pipe and, due to gravity, settles over the water. Process continues until piping between the water level and the steam line is completely air bound.

Air in the level-control piping does no harm. But, to cure the condition, *JWG* can connect the 1½-inch pipe to the top of the steam main (alternative *A* in the sketch above). Such an arrangement prevents air from rising into the small line. If this change is not convenient, connect a ½-inch test valve in one of the three vertical lines (alternative *B*). When pipes cool and the operator wants to be sure piping isn't plugged, he opens the test valve and bleeds out the air. Deaerator control lines will quickly get hot again.

A Di Lorenzo — *Brooklyn, N. Y.*



Install orifice or control valve

The sketch above shows the assumed deaerator piping arrangement. No. 1 deaerator is the first to receive steam. Unless *JWG* installs some kind of control for regulating pressure, No. 1 deaerator will receive more steam than the others. No. 3 will get the smallest amount of steam.

At startup, the pressure difference between steam supply and water in the deaerator is great enough to cause large steam-flow rates, thus keeps the level-control piping hot. After some time the pressure difference drops off, reduces steam flow and causes piping to cool.

By installing a flow restricting device such as an orifice or control valve in the steam-supply line to each deaerator as shown in the sketch above, an even pressure and temperature distribution can be maintained at all times. The arrangement provides required deaerator pressure for all likely flow rates. Also, a control valve permits balancing the system when one or more heaters are taken out of service.

H B Wayne — *Woodhaven, N. Y.*

JWG has a no-flow steam condition

JWG's trouble is due to a no-flow condition of the steam. Insulating the lines would not prevent them from cooling off. It would just prolong the cooling period.

Piping and valves are not at fault either. Since pressure and temperature in all deaerators are equal, little or no flow of steam or water takes place in the equalizing lines. Thus a temperature gradient is set up from the point of take-off at each deaerator to a point somewhere in the equalizing line. And, since the level control piping is even further isolated from the deaerators, effects of the no-flow condition are more pronounced.

The temperature gradient due to the no-flow condition can be eliminated by causing a flow to take place. *JWG* can do this by installing a nipple on the upper 1½-inch lead to the controller. At the end of this nipple he should hookup an orifice in the form of a drilled plate. A valve would also do the job and would permit him to select a suitable opening for venting steam to the atmosphere. This arrangement allows steam to flow from all deaerators through the equalizing line and into the 1½-inch controller piping.

A small steam flow is all that *JWG* needs to keep the 1½-inch piping hot. Best way to find required flow: Install a small valve and crack it slightly until the lines remain hot. Deaerator steam loss is negligible.

A J Breugelmans — *New York, N. Y.*

Want help with your plant problems? Send in your design and operating headaches to us. We'll give Power readers a whack at them.

Turn page for info on emergency water supply ►

More PLANT PROBLEMS Begins on page 138

The question

How should we set up emergency water supply?

We have a 160-bed hospital that uses about 30,000 gallons of water per day. But during an emergency we could probably get by on a lot less.

Water cooled auxiliaries, such as generators and air compressors, make continuous water flow vital. Our present source is an 8-inch city main, lime soda softened. All hot water is zeolite softened to zero hardness. We also have two electrically driven booster pumps but these couldn't be used during a power outage since they aren't on the emergency generators. They're intended for a future fifth floor and are now used only when city-water pressure is low.

Ours is a limestone area and well water is hard. But emergency water could be valved into the existing 8-inch main in the boiler room, so hot water and boiler makeup could be softened before use, as it is now. I believe well water in sufficient capacity for emergency use could be reached at 100- to 125-foot depth.

What system is best for us? Deepwell with pump, elevated storage tank or reservoir? Whichever system is used, it must be automatic and independent of utility power, since the local utility might also be interrupted during an emergency.—*GRD*, August *Power*

The answers

Probable length of emergency time must be estimated first

For high reliability within the tank's capacity limits, an elevated tank is probably the first choice. It can be valved for automatic gravity feed when public-water supply fails. And it will yield the same water quality *GRD* gets from the regular supply.

A well has the advantage of being able to supply water needs for a much longer emergency than a tank. But the adequacy of a well source is speculative until proven. A bid from a reliable well driller who will give a money-back guarantee to produce the required volume and quality of water might be worth the extra cost and reduce the speculation factor.

A reservoir requires a pump and automatic control to start water flowing when public supply fails.

No intelligent choice can be made without first estimating the length of time to be covered in an emergency. An economic comparison can then be made which will provide a sound basis for going ahead with either the tank or the well. *GRD* might do well to call in a consultant.

I A Butcher — *Cincinnati, Ohio*

How about firefighting needs?

Not mentioned by *GRD* are his firefighting needs. These can be quite large—1000 gpm or more. Thus consideration of fire supply will influence the decision.

Chances are, electric-power failure, public-water supply failure and too low a supply capacity have to be taken into account. Here are four possible action courses:

(1) Investigate the cause of occasional low city-water pressure. Piping may be too small to carry peak summer and fire loads. Larger pipe may be needed.

(2) Provide ground storage at the hospital with gasoline-engine-driven standby pumps. Engines can be on manual or automatic control. Quantity of storage depends on whether or not firefighting needs are to be accounted for.

If tank is underground, *GRD* runs the risk of water contamination from sanitary disposal facilities. A ground-level tank eliminates this problem.

(3) Provide elevated storage and use present booster pumps to keep it filled. An automatic valve would have to be installed to let water flow from elevated storage when city pressure drops. Gravity supply eliminates dependence on pumps. And, since a fifth floor will eventually be added to the hospital, elevated storage can be used for domestic water on upper floors.

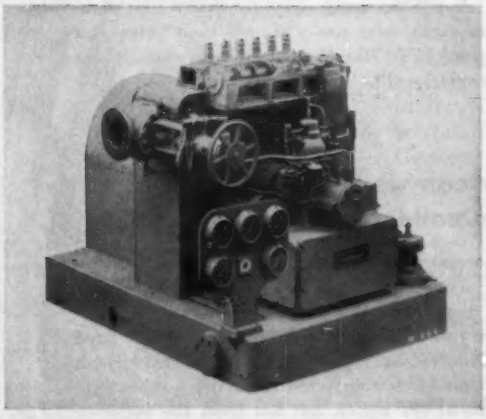
(4) A well supply can be developed. Pumps can be gasoline-engine driven. But, unless ground water is unusually abundant, it is doubtful that a well can supply adequate fire flow capacity directly. Storage would probably be required for the fire supply.

J A Novaro — *New Haven, Conn.*

Turn page ▶

NIGHT VIEW of Cities Service Refinery, Lake Charles, La.

Worthington steam turbines keep refineries on stream



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STEAM TURBINES

More PLANT PROBLEMS Begins on page 138

My figures favor the well

At 30,000 gpd, the hospital needs about 21 gpm. Assuming a deep well head of 150 feet including pipeline losses, a 1-hp pump having 80% efficiency would do the job. Water flow could be kept at normal levels for long periods of time provided well capacity is adequate. For the upper floors a small booster pump could be used.

Assuming the hospital could get along with a supply of 20,000 gpd, a storage tank 20-feet high and 20-feet diameter would supply water at this flow for only 2 1/3 days. Power has been known to be cut off for much longer periods, especially with the wave of recent hurricanes.

H J WYMAN *Boston, Mass.*

I would install an elevated tank

Considering all points raised by *GRD*, I believe an elevated tank would be most practical. The tank would hold about a 3-day supply and would be about 24-feet diameter by 30-feet high. It should be elevated sufficiently to provide a suitable static pressure to the highest use point.

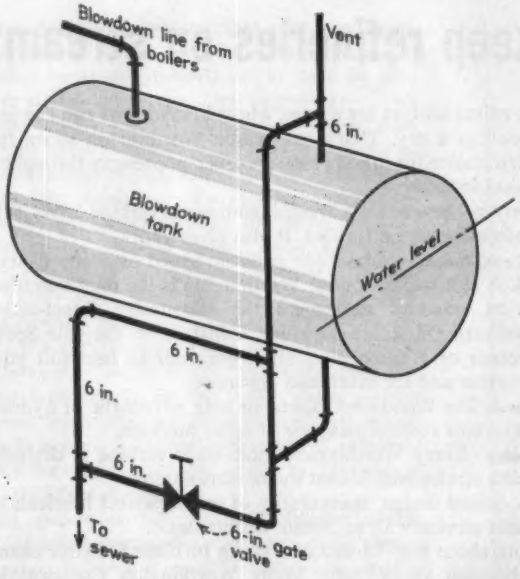
The tank would give continuous water-supply service by providing constant filling from the city mains. It would be controlled by a float valve. Such an arrangement would also maintain a constant change in water storage, preventing any brackishness that might result from still water.

Since the elevated-tank discharge is by gravity, the system is completely self-sufficient and automatic during an emergency. A 3-day supply should cover any ordinary suspension of service that might occur in a municipal system.

Concerning auiliary equipment, *GRD* might reduce operating expenses by erecting cooling towers. The system would require little makeup water and could be adapted to any cooling need except possibly ammonia compressors and other equipment where a possible leak could contaminate the cooling water. If the cooling-tower idea is used, a good corrosion inhibitor should be added because free oxygen entering the water during water's contact with the atmosphere is highly corrosive.

L C VAN HUBEN *Orangeburg, N. Y.*

Your November Problems



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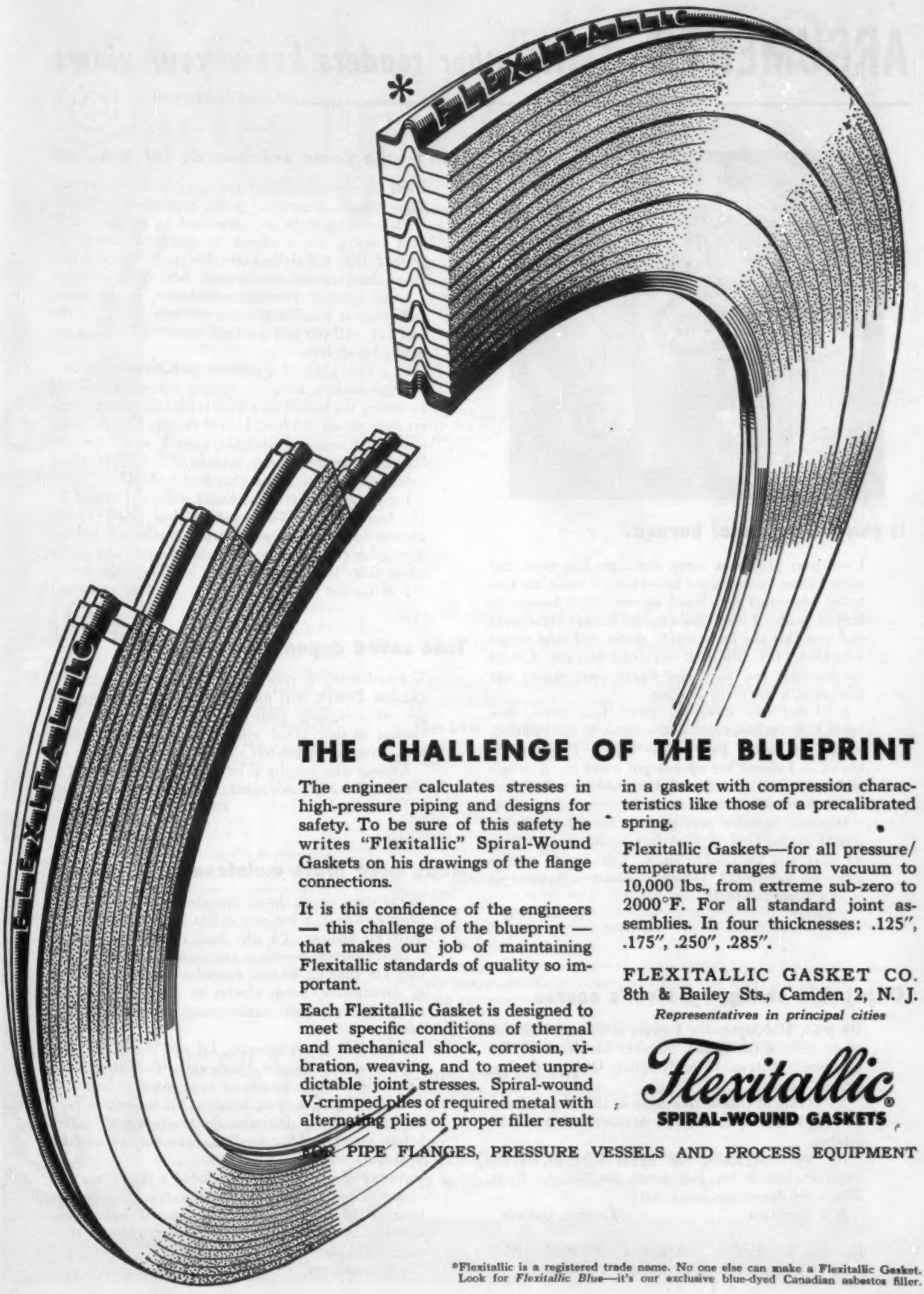
2 How can we dispose of ash after collecting it?

Much information is available on the proper collection of flyash but little is said in the literature about the disposal of this ash after collection.

We have two 10,000-lb-per-hr spreader-stoker-fired boilers. They're equipped with mechanical flyash collectors. Flyash is reinjected from the hopper into the last pass of the boiler, but not from the collector itself.

We collect about seven cubic feet of ash per day. How can we dispose of it with a minimum of expense and without creating a nuisance? Perhaps some *Power* readers have found good solutions to this problem.—*HDF*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.



THE CHALLENGE OF THE BLUEPRINT

The engineer calculates stresses in high-pressure piping and designs for safety. To be sure of this safety he writes "Flexitallic" Spiral-Wound Gaskets on his drawings of the flange connections.

It is this confidence of the engineers — this challenge of the blueprint — that makes our job of maintaining Flexitallic standards of quality so important.

Each Flexitallic Gasket is designed to meet specific conditions of thermal and mechanical shock, corrosion, vibration, weaving, and to meet unpredictable joint stresses. Spiral-wound V-crimped plies of required metal with alternating plies of proper filler result in a gasket with compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets—for all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

More PLANT PROBLEMS Begins on page 138

My figures favor the well

At 30,000 gpd, the hospital needs about 21 gpm. Assuming a deep well head of 150 feet including pipeline losses, a 1-hp pump having 80% efficiency would do the job. Water flow could be kept at normal levels for long periods of time provided well capacity is adequate. For the upper floors a small booster pump could be used.

Assuming the hospital could get along with a supply of 20,000 gpd, a storage tank 20-feet high and 20-feet diameter would supply water at this flow for only 2 1/3 days. Power has been known to be cut off for much longer periods, especially with the wave of recent hurricanes.

H J WYMAN *Boston, Mass.*

I would install an elevated tank

Considering all points raised by *GRD*, I believe an elevated tank would be most practical. The tank would hold about a 3-day supply and would be about 24-feet diameter by 30-feet high. It should be elevated sufficiently to provide a suitable static pressure to the highest use point.

The tank would give continuous water-supply service by providing constant filling from the city mains. It would be controlled by a float valve. Such an arrangement would also maintain a constant change in water storage, preventing any brackishness that might result from still water.

Since the elevated-tank discharge is by gravity, the system is completely self-sufficient and automatic during an emergency. A 3-day supply should cover any ordinary suspension of service that might occur in a municipal system.

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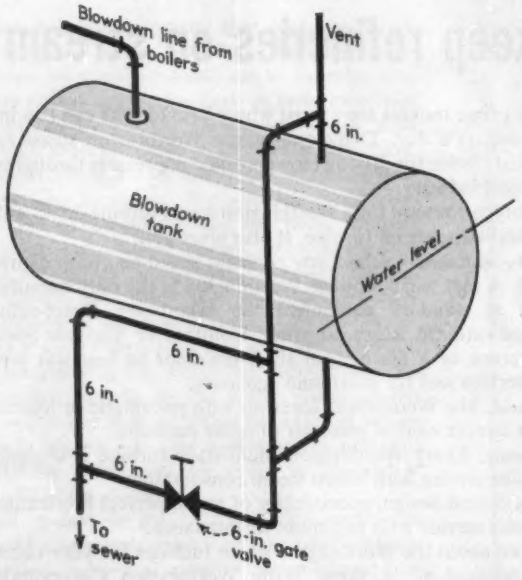

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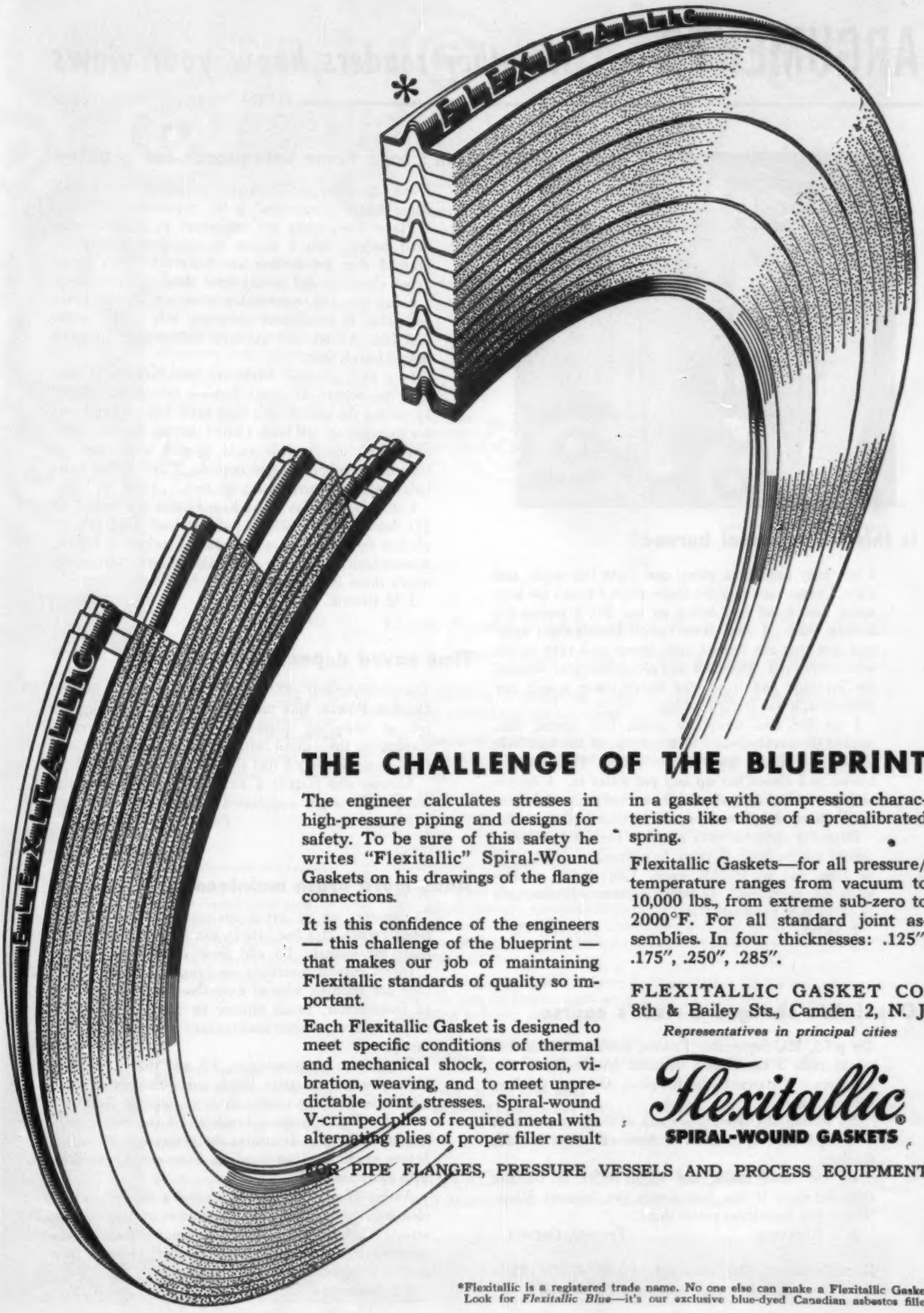

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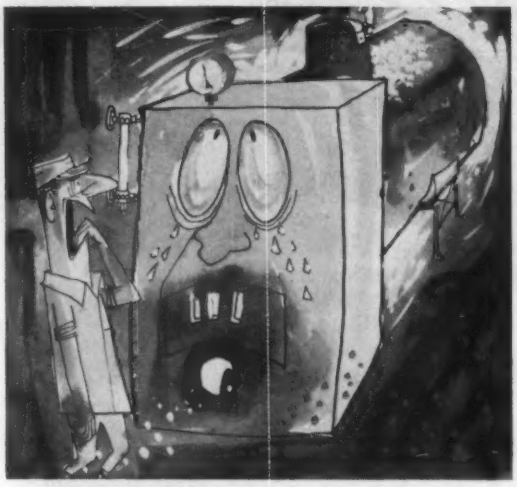
ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*



Is this boiler metal burned?

I was busy packing a pump one night last week, and when I came back into the boiler room I found the low-water fuel cutoff had failed on our No. 2 locomotive firebox boiler. I shut down the oil burner right away and saw that the firebox side sheets and tube sheets were cherry red. The shell was plenty hot, too. Around the manhole and handholes where there wasn't any insulation, it was really cooking.

I let her cool down for about four hours, then opened the manhole and took out one of the handhole plates so I could look at the tubes. They weren't bowed so I closed her up and put water in. A couple of tubes leaked at each end, but after we rolled them tight, there didn't seem to be anything else wrong.

Day-shift operator says metal is burned and boiler should not be fired. I think he's wrong, especially as we have had no trouble since. Can POWER readers settle the argument? Is boiler permanently damaged by this amount of heat?

J SMITT *Norfolk, Va.*

Oops! We changed a river's course

On p 66, Mid-September POWER, there's an item that might raise a Canadian's dormant hackles by a few whiskers. "Ottawa Civic Hospital, Ottawa, Quebec, Canada," it says.

No section of Ottawa lies north of the Ottawa River. The city is entirely in Ontario. Across the river is Hull, Quebec.

By the same token, one might refer to Buffalo, Ontario, since it lies just across the Niagara River. Would you Americans notice that?

A E RICHARDS *Toronto, Ontario*

EDITOR'S NOTE: *Our map agrees with reader Richards. We apologize to all interested Canadians.*

Don't take flame safeguards for granted

I was impressed by "What you can expect from today's flame-failure safeguards," p 90, September POWER.

Flame safeguards are important to automatically-fired boilers, but I object to operators taking for granted that the devices are foolproof. They forget about checking and testing until there is an accident.

I say purging combustion chamber, smoke boxes and tubes is insufficient when you rely solely on the fuel fan. All oil- and gas-fired boilers need adequate induced-draft fans.

In a new gas-fired stationary installation with firebox-type boilers, adequate furnace volume was added by setting the boilers on a high brick box. When burners were put on full load, I noted that air inlet dampers controlling the fuel-air ratio opened wide; yet the breeching damper barely moved. Why? "The trend today is to conserve heat, not fuel." *Nuts!*

I think explosions in packaged units are caused by (1) faulty design (2) no induced-draft fans (3) explosion doors that do not operate (4) human failure. Atmospheric conditions also take a hand, especially where there is a cold stack with high humidity.

J M GORRIE *Euclid, Ohio*

Time saved depends on the men

The conveyor-belt splicing system pictured on p 140, October POWER, will undoubtedly help speed up the job of installing plate-type fasteners. The exact amount of time saved will probably depend on how the men doing the job feel about it.

Anyone who installs a lot of fasteners will find it worthwhile to get acquainted with these tools.

JIM ADAMS *Packanack Lake, N. J.*

Adds more brush maintenance pointers

"6 pointers on dc brush maintenance," p 124, October POWER, is a fine article, but I don't think it goes quite far enough. I'd add these comments:

Direct current machines are running smoothly when they are running without excessive sparking, burning of commutator, brush chatter or other damage that may cause expensive maintenance or costly replacements.

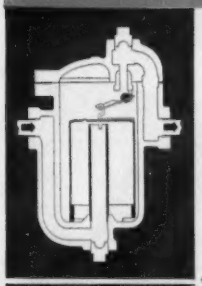
Regarding brush pressure, I'd add that if it is too high, you get excessive brush and commutator wear. Too little pressure results in poor commutation.

Under Fig. 4, seating brushes, I'd suggest inspecting brush faces to determine the percentage of surface before sanding. After sanding, blow out the machine with compressed air.

Author should also have included a sketch showing cleaning, stoning, and in extreme cases turning commutator by lathe. Where copper is removed from a commutator, by undercutting or otherwise, clean it thoroughly with suction.

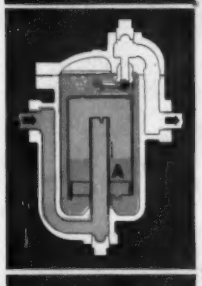
J E NORDQUIST *New York, N. Y.*

How Armstrong Trap Design Improves Plant Efficiency . . .

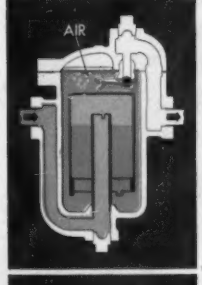


1 When trap is first installed, the inverted bucket is down and the valve is wide open. The large clearance between valve and seat minimizes restriction to condensate flow, contributing to large capacity.

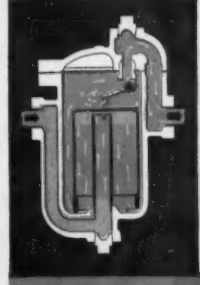
2 When steam is turned on, note how condensate (solid color) flows down between bucket and trap body, then up and out through orifice. Dirt is held in suspension and washed out when valve opens.



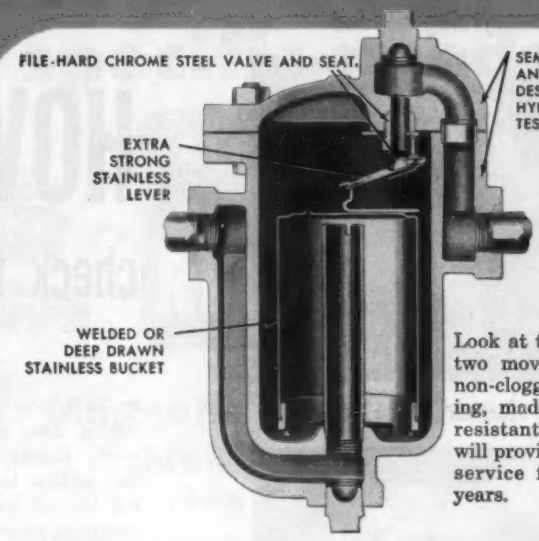
3 When steam reaching trap displaces less than ⅓ of the water in the bucket, it floats, closing the valve. Generous safety margin (dimension A) insures that steam will never reach trap orifice.



4 When more condensate enters trap, the bucket loses buoyancy and pulls on valve lever. (Note how incoming air passes through bucket vent and collects at top of trap, awaiting discharge.)



5 When weight of bucket times leverage overcomes pressure on valve, trap opens, creating momentary pressure drop that "pumps" condensate and non-condensibles from unit being drained.


FILE-HARD CHROME STEEL VALVE AND SEAT.
SEMI-STEEL BODY AND CAP. 250 LBS. DESIGN PRESSURE—HYDROSTATIC TESTED AT 500 LBS.
EXTRA STRONG STAINLESS LEVER
WELDED OR DEEP DRAWN STAINLESS BUCKET

Look at this trap. Only two moving parts. It's non-clogging, non-sticking, made of corrosion resistant materials. It will provide trouble-free service for years and years.

Time-Tested Inverted Bucket Principle Provides Five Cost-Reducing Benefits:

The modern Armstrong Trap is unsurpassed in these five major contributions to plant operating efficiency:

1. Fast heat-up—thanks to large condensate and air handling capacity. On batch or cycled production, you get maximum output per day.

2. High heat transfer rate—quick opening creates a sudden surge of condensate and air from the unit being drained. This pumping action prevents stratification of incondensibles and insures complete drainage. Laboratory and field tests prove it produces higher heat transfer than is otherwise possible.

3. Low Fuel Consumption—non-productive radiation losses are minimized because condensate is discharged at steam temperature as fast as it accumulates in the trap—you get more production per hour and per unit of fuel. And, there is no steam loss through the trap orifice.

4. Continuity of operation—the trap always opens for condensate; the simple, sturdy, self-cleaning mechanism insures continuous operation between inspections without interruption of processing.

5. Low Maintenance—no trap has ever gained so enviable a record for trouble-free service—ask anyone who has kept records.

Free: Steam Trap Book—
44 helpful pages on trap selection, installation maintenance, physical data and prices. Call your local Armstrong Representative or Distributor, or write:

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ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

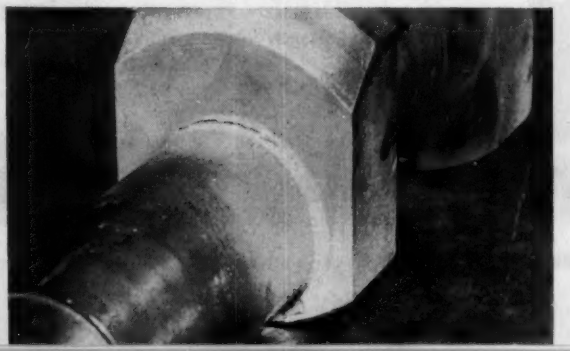
1 Kit has everything needed

2 Spray on cleaner, wipe off

3 Spray on penetrant

4 Wipe off penetrant

5 Shake can, spray developer ... inspect. Defects appear red



HOW TO

check for flaws

► Now, portable spray-on dye penetrant helps you find hidden flaws during maintenance in the field or in your plant. Cracks, seams, porosity and other defects open to the surface in most solid materials are quickly located. Kit has all needed materials including ready-to-use, self-contained pressurized spray cans.

Since fatigue cracks invariably start on the surface, this is one of the kit's most important uses. You can check questionable or critical areas on large or small parts if you're in doubt. Only requirement is that surface be relatively clean. Reason is that foreign material can cover the defect and make it impossible for the penetrant to enter the flaw.

Plants are now using these kits to periodically check crane hooks and lifting equipment. They're also used to check parts of engines such as shafts, gears, housing, etc, especially if flaws are suspected.

Surface in aluminum, magnesium, brass, copper, iron, stainless, carbides, stellite, plastics, ceramics and almost any non-porous solid can be checked.

Defects such as shrinkage cracks, shrinkage porosity, cold shuts, fatigue cracks, grinding cracks, seams, forging laps and bursts are quickly found.

Use on castings, forgings, machined parts, sheets, pipe, weldments, tubing, insulators, carbide-tipped tools, critical areas and on many other shapes and parts that you operate.

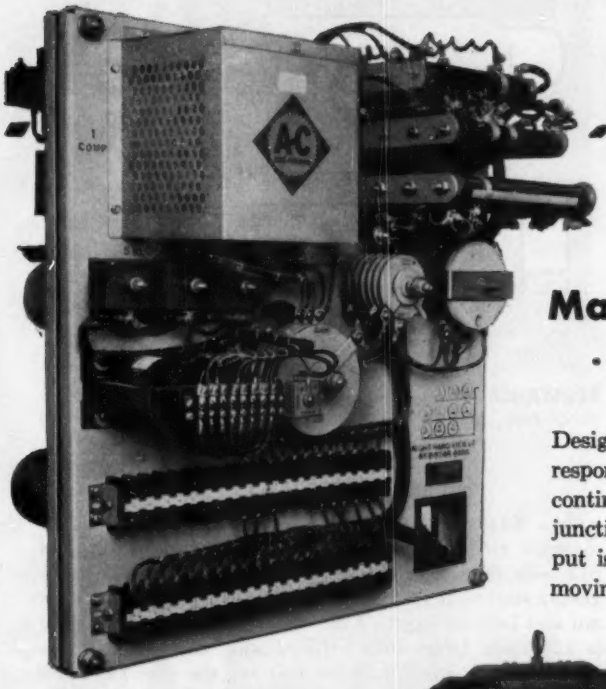
—Courtesy, Magnaflux Corporation, Chicago, Illinois.

Small?

Medium?

Large?

A size and type for your specific needs



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Magnetic Amplifiers
...high sensitivity
...low maintenance

Designed for applications requiring high sensitivity and response, where regulator is subjected to shock, or where continuous performance is a prime factor. Used in conjunction with *Regulex* unit when reversed polarity output is required. Since the magnetic amplifier has no moving parts it requires little maintenance.

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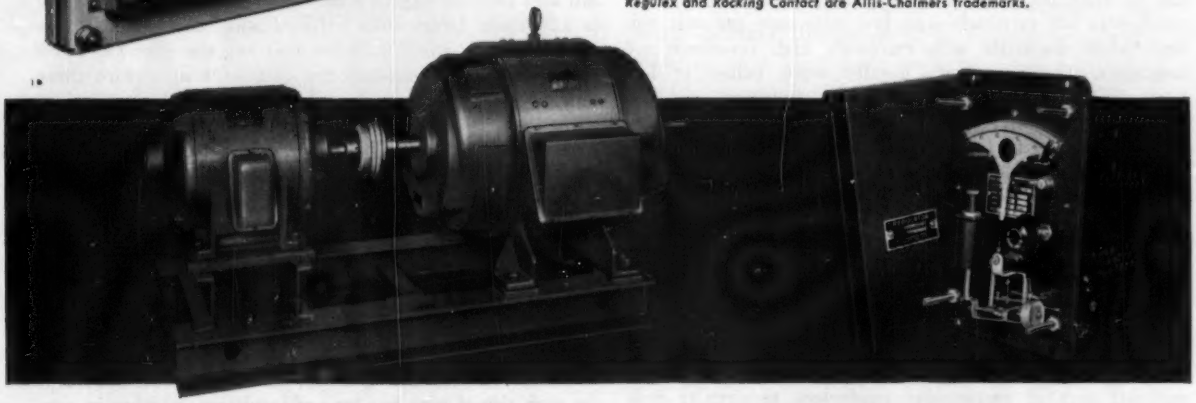

Regulex Rotating Regulators

- Stability during high power-factor operations.
- Increased operating limits through automatic minimum excitation.
- High sensitivity and rapid response.

For complete answers to any regulator problem, call your A-C representative, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

Rocking Contact Regulators for voltage regulation of smaller ac and dc generators.

- Varies resistance in exciter shunt field by rocking action of contacts.
- Quick regulation over entire range with short movement of contacts.
- No sluggish relays.
- No vibrating or sliding contacts to wear.

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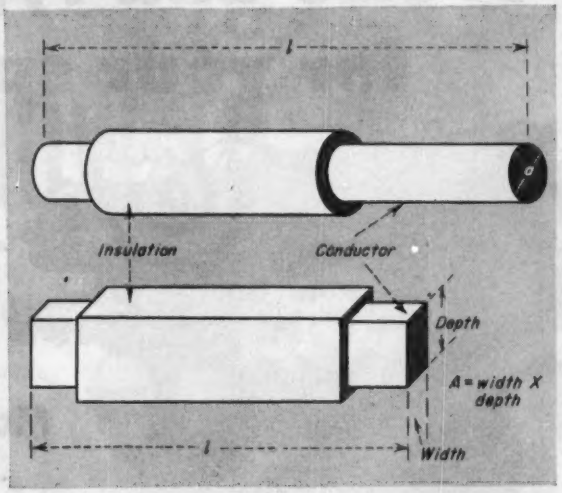
BASICS . . . bringing engineering theory down to earth

NORMAN PEACH, *Assistant Editor*

Electricity: 4

Conductors and resistance



RESISTANCE of conductors depends on length, cross-sectional area, and resistivity of copper, or other material used

► ANY MATERIAL allows some current to flow through it when an emf is applied across it. If the current is large enough to be useful, the material is called a *conductor*. If the current is too small to be of consequence, the material can be regarded as an *insulator*. Looked at another way, conductors are materials with low resistance per unit volume, while materials with extremely high resistance are insulators. Conductors are usually wires, cables or bus bars. They are "pipes" for carrying electricity, and you want them to have as little resistance as is practical. Resistors are special kinds of conductors placed in a circuit for a definite purpose.

Resistance of conductors varies directly with length and resistivity, and inversely with the cross-sectional area. *Resistivity* is resistance per unit volume of the material from which the conductor is made. Resistivity is sometimes expressed in ohms per cubic centimeter, but a more practical unit volume is the *circular mil-foot*. That's a cylindrical conductor (wire) one foot long with a diameter of one mil (0.001 in.). It's usually convenient to convert cross-sectional area of rectangular conductors to circular mils since most resistivity tables are based on circular mils. Multiply number of square mils by 1.26 to get circular mils.

Resistance of a conductor is found by formula: $R = \frac{\rho l}{A}$

R is resistance of conductor in ohms, l is length in feet, ρ is resistivity in ohms per circular mil-foot, and A is cross-sectional area in circular mil-feet. Similarly, l could be in centimeters, ρ in ohms per cubic centimeter, and A in square centimeters.

For wires the formula becomes: $R = \frac{\rho l}{d^2}$

Where ρ is resistivity in ohms per mil-foot, l is in feet and d is diameter of the wire in mils.

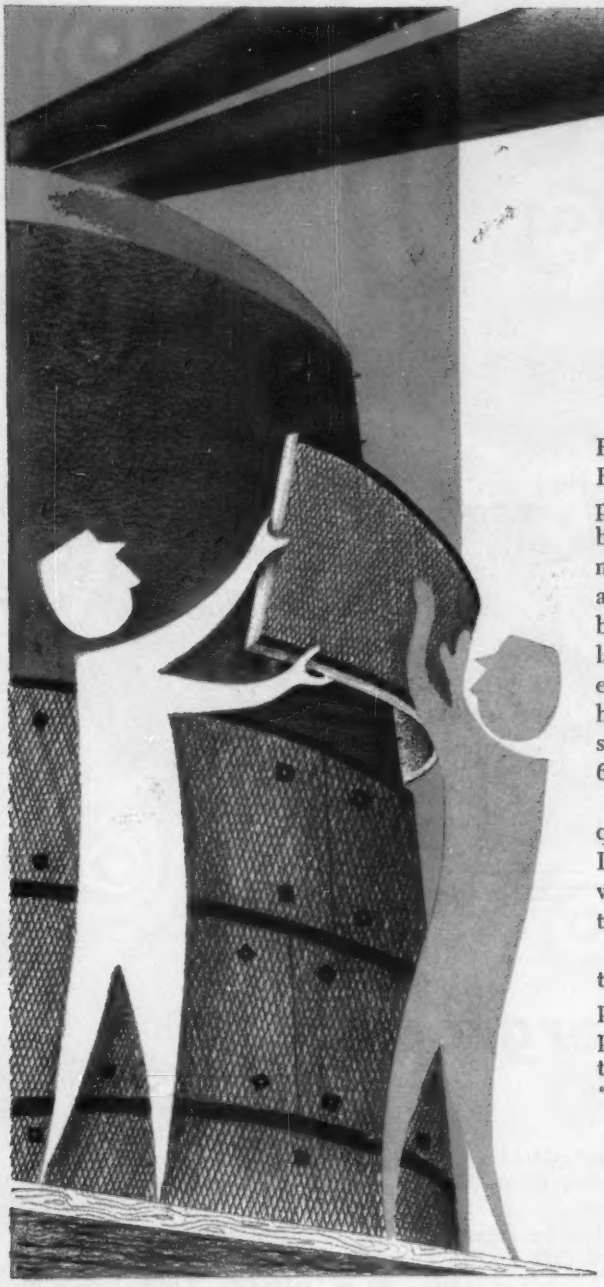
Wire sizes have been standardized in the American Wire Gage (AWG). Largest size with gage number is No. 0000, with a diameter of 460 mils. Wires and cables of larger diameter are designated by circular-mil area. AWG sizes run from 0000 through 000, 00, 0, 1, 2, 3, etc, the wire getting smaller as the number gets larger. Ratio of circular-mil area between sizes is 1.26. This means that a No. 1 wire is 1.26 times larger than a No. 2 wire, and has 1.26 less resistance. It's handy to know that any size wire has twice the diameter and one-half the resistance of a wire three numbers larger. *Example:* one No. 17 wire is equivalent to two No. 20 wires. Also, the ratio between the size of a wire and another 10 numbers larger is 10 to 1. Stranded cables are made equivalent to AWG sizes in circular-mil area. Cables have a slightly higher resistance per foot because of the extra length of the spiralled strands.

What size wire should you use? Most important consideration is usually the effect of heat on the insulation. Heat is proportional to current squared times resistance (I^2R), so for a given set of conditions, resistance must be small enough to keep heat within permissible limits. The National Electric Code specifies maximum allowable current for each size of wire and type of insulation, whether in conduit or open, etc.

Next in importance is voltage drop. Once you know current capacity of wire from heat point of view, figure out the IR drop. If it's greater than you can permit, calculate what size wire will give you a small enough voltage drop. Obviously, long runs require larger size wire than short runs.

Insulation and flexibility have to be thought about as well as size. Insulation has to be right to withstand voltage of circuit, and must not deteriorate as result of surrounding conditions, such as moisture, unavoidable heat, or corrosive fumes.

Resistance changes with temperature. With most materials used for conductors the resistance goes up as the temperature goes up. There are special alloys that have a very small resistance change with a (*Continued on page* 198)



Flexible blanket speeds insulation of large, heated equipment

Flexible, easily handled Armstrong Armatemp* Blanket Insulation is especially fast and easy to apply to the curved and irregular surfaces of tanks, breechings, heat exchangers, and other large equipment operating up to 1200° F. Armatemp Blankets are made of felted layers of mineral wool, faced on both sides with various combinations of wire mesh, lath, and fly screen. The insulation's smooth, firm edges can be butted tightly together for efficient, heat-tight joints. Armatemp comes in standard sizes of 2′ x 4′ and 2′ x 8′ and in thicknesses of 1″ to 6″. Special sizes are also available on order.

Armatemp Blanket Insulation is one of the many quality products in the complete line of Armstrong Industrial Insulations. Armstrong also offers a well organized contracting service, geared to install these materials efficiently and economically.

For additional information on Armstrong Armatemp Blanket Insulation or any other Armstrong product that may help to solve your insulation problems, send today for free booklets. Check the ones you want on the coupon below.

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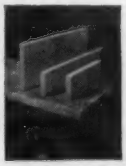

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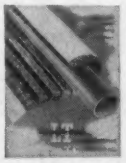

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"That evening I went downtown and tackled the problem from the ground up," said Marmy

Marmy goes underground

► "BILGEWATER on engineers who refuse to study their blueprints," roared Marmaduke Surfaceblow as I stepped into the Bent Propeller Bar the other evening.

Edging up to the crowded bar, I ordered a short beer and listened. The old consulting engineer was already in his sounding-off pose—backed against the bar, gray bowler at a starboard list on his silvery dome, thumbs hooked into the armpits of his checkered vest—and looking belligerently at his burly waterfront audience. Then he blasted away again in his foghorn voice.

"Back in the winter of 1926, I quit my job as nursemaid to a couple of sawmill boilers at an Oregon lumber camp. Then I headed for Billings, Montana by side-door pullman to look up my old shipmate Hank Younger. Next midnight, with the temperature around zero, I hopped off at the local freight yards and made tracks for a beanery. After stoking my boilers I barged into the Railroad Hotel to thaw out and catch a little shut-eye.

"Eighteen hours later I got out of the bunk, shaved and headed for Hank's garage in the center of town. After we had caught up on old times and I had looked his place over, Hank told me about an operator's job at the local water-pumping station. I was interested because that meant I could help Hank around his garage in my spare time. I expected to ship out the next spring on the Great Lakes.

"The pumping station was owned by the local technical institute. It was a combination trade school and college that offered courses in academic and pre-engineering subjects. Mechanical courses included machine shop, welding, auto and tractor mechanics, armature winding, etc.

"I took the job and started on the 8 pm to 8 am shift. This station had two shifts of 12 hours each, for seven days a week. We repumped domestic water to the school's various buildings and to a new residential community. Main pump was a large steam duplex job of 12x14x8 in. It pushed water up some 140 feet into a small reservoir on a hill in back of the school buildings. From there the water flowed by gravity to the buildings and homes.

"Buried water mains had been laid years before and were made of wood. Supply main to the pump was 8-in. diameter and about 1½ miles from the city reservoir. Pump's suction line was reduced to 6 in. diameter. Water reached the pump under a positive head of about 6 psi.

"Besides the main pump, we had an emergency or auxiliary duplex pump. It had about one-third the main-pump's capacity and was cross-connected so it could either feed the boilers in the

(*Continued on page* 192)

Allis-Chalmers Pumps Meet Power Plant Requirements

Continuous Condenser Service at Detroit Edison's River Rouge Plant

At River Rouge Station, these Allis-Chalmers 84 by 60-inch circulating pumps, driven by 500-hp motors, deliver 73,000 gpm to the A-C condenser.

They play an important part in assuring service continuity at this station. An accurately cast impeller, hand finished and dynamically balanced, assures smooth operation. Other features, including a rigid whip-free shaft, and tube-protected shaft and rubber bearings lubricated with filtered water, have made A-C circulating pumps popular throughout the power industry.

Many customers use Allis-Chalmers test facilities to properly design their intake structures.

You Get **MORE** than a Pump . . . When You Specify Allis-Chalmers

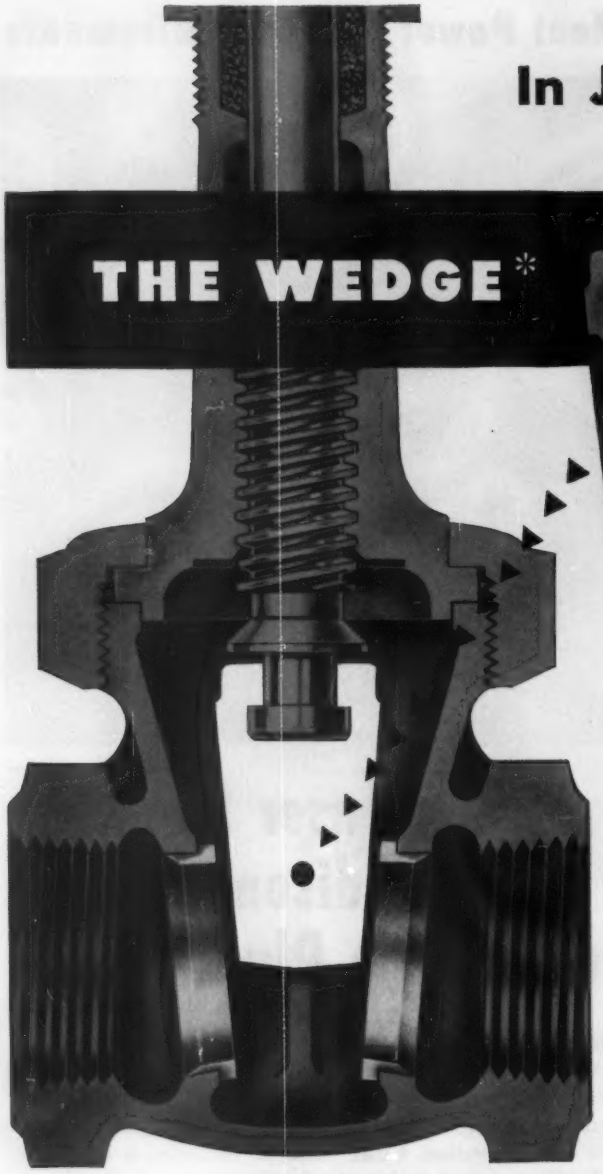
You can take advantage of Allis-Chalmers wide experience in supplying pumps to all industries. You are assured of modern design, heavy-duty construction and correct application aid — all adding up to many years of dependable service.

Allis-Chalmers is the only company that can offer you "One-Source" responsibility, with a complete unit — pump, motor and control — all built to work together. For "MORE" information about Allis-Chalmers pumps, call your local A-C office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin. A-5216

ALLIS-CHALMERS

In JENKINS Monel-Seated

THE WEDGE* TAKES THE



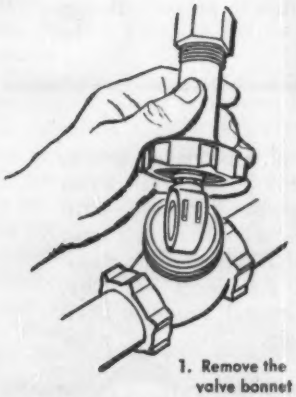
THE RENEWABLE WEDGE (bronze or nickel alloy) has excellent wear resistance, but has a lower degree of hardness than the heat-treated Monel rings, which have optimum resistance to erosion and corrosion as well as abrasion. Thus, wear of the wedge leaves the rings relatively unaffected.

***MADE WITH BRONZE OR NICKEL ALLOY WEDGE** The bronze wedge provides lasting economy for most applications. The nickel alloy wedge provides extra resistance where severe abrasion or corrosion are factors.

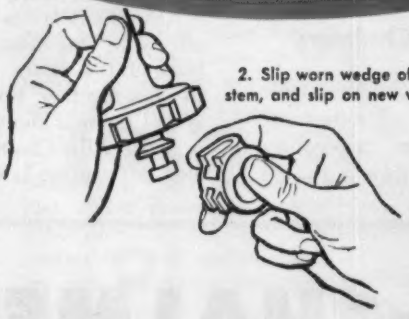
JENKINS BRONZE GATES WITH MONEL SEAT RINGS

200 psi	300 psi
Fig. 270-U, Bronze Wedge	Fig. 280-U, Bronze Wedge
Fig. 270-UN, Nickel Alloy Wedge	Fig. 280-UN, Nickel Alloy Wedge
Fig. 270-UL, Bronze Wedge, U. L. approved for L.P.G. Services	350 psi
	Fig. 280-UX, Bronze Wedge

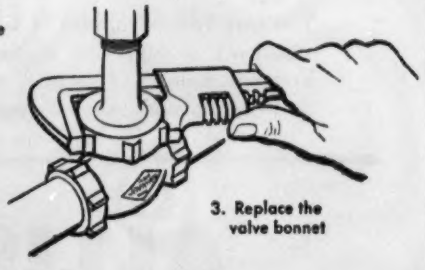
Replace the wedge only — in minutes — right on the line — to restore full efficiency



1. Remove the valve bonnet



2. Slip worn wedge off the stem, and slip on new wedge



3. Replace the valve bonnet

Bronze Gates

WEAR-AND SPARES THE RINGS

The Monel Seat Rings are in to stay — expanded-in — to last for full life of valve. Here's why . . .

INSTALLING SEAT RINGS in a gate valve is a job for experts, even when it's new. But look into a valve (like the one shown here) that has been in service long enough to need part replacement . . . the kind of tough, punishing service that Monel-seated gates are designed for. You'll see why Jenkins valve specialists decided to provide practical, fast, economical renewability by simply changing the wedge, — *not the rings.*

IN JENKINS MONEL-SEATED GATES, the seat rings are expanded into the body to assure a positive, leak-proof joint. This permanent, all-around support of the rings is essential to guard against deforming, loosening, or shifting under the most severe conditions of service.

GET PRACTICAL, LOW-COST RENEWABILITY along with dependable resistance to wear and corrosion. Compare . . . there is nothing simpler, faster, or more economical than renewal in Monel-seated Gates of Jenkins design . . . and you also get the *plus* of Jenkins *extra value* in every other feature. Jenkins Bros., 100 Park Ave., New York 17.

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SCREWED • FLANGED • SOLDER END • SOCKET END • QUICK OPENING

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Reader service section

Start with these quick samples...

'Tenshun . . .

to this month's story on the latest research developments. Electroluminescence and fuel cells are making the headlines. Researchers report substantial progress and predict a bright future for these new sources of light and energy. If you want to keep pace with progress, make a habit of turning to . . .

Reports From the Field, p 156

Count off . . .

one, two, three, four. That's the number of categories covered in our review of technical papers. This month, generators, electrical developments, hydro projects and corrosion are featured. We've put the info into capsule form for your convenience. And if you want the full reports, we tell you how to get them.

Technical Briefs, p 158

Forward march . . .

that's the only way to make progress. And the only way to stay ahead in the power field is by using the newest and best equipment. A quick way to check your plant's status is by reading . . .

Plant Equipment News, p 162

On the double . . .

if you don't want to miss a bargain. We've listed some forty-odd manufacturer's bulletins this month, full of helpful hints and handy reference charts. All you need to get your share is the price of a 2-cent stamp. We provide the postcards.

Free Literature, p 171

At ease . . .

Relax and enjoy a visit with our old engineer-philosopher. He has some sage advice to offer on the subject of politics; and be you Democrat or Republican, you're bound to agree with . . .

George Edwards, p 174

For other timely ideas, see following service pages ▶

How it Works!

Only new Sarco TD steam trap uses kinetic energy of steam to close valve

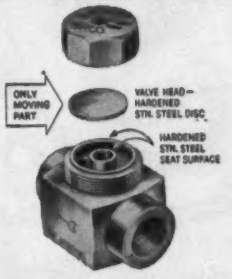
GAS MANTLES have been replaced by electric lights, steam locomotives by diesels, propeller planes by jets.

Now, the use of the kinetic energy of steam principle gives us a modern type of steam trap.

The Sarco TD obsoletes all other types for most 10 to 600 psi installations. For example, it operates without a valve closing device—no bucket, float, bellows, pins, levers or gaskets.

Glance below and you'll agree that no other steam trap is even similar to the Sarco TD!

For a trial installation—write today.



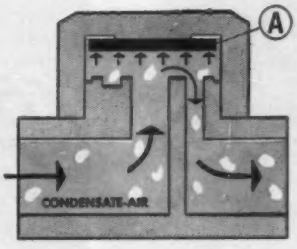
Only 3 parts... all stainless steel

Sizes ⅜ to 1"—each body is as small as a tee fitting! Capacity is determined not by a bulky body but by the effective orifice, valve action, pressure drop and condensate temperature.

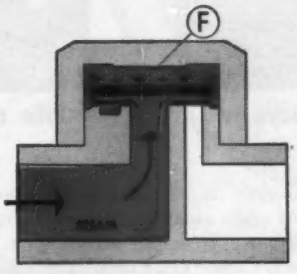
Many Advantages

1. *Practically no maintenance*—no valve mechanism, no narrow channels. Trouble-free simple design. Only 3 parts—all stainless steel.
2. *One trap for all pressures*—self-adjusting. One large capacity seat for 600 psi as for 10 psi. No changes or adjustments.
3. *Operates equally well on all loads*—on heavy, light or no condensate load. No prime to lose. No adjustments.
4. *No steam leak required*—to operate the Sarco TD. Closes tight against steam.
5. *Discharges at steam temperature and vents air* and air-steam mixtures at start-up and during operation.
6. *Freeze-proof*—when installed with outlet down, free to drain.

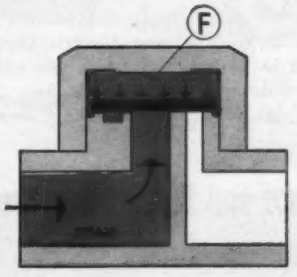
Only Sarco TD Thermodynamic Steam Trap Uses This Unique Operating Principle Which Permits Trouble-Free TD Design



1. Inlet pressure raises disc "A" from seat... immediate discharge of air and condensate at steam temperature.



2. Steam follows the condensate and the high velocity jet across the bottom of disc "A" creates a low pressure area (Bernoulli effect)... the jet is deflected into chamber "F" where it builds up pressure by recompression and this pressure acts on the top of the disc "A"...



3. Pressure in chamber "F", acting on full top area of disc "A", exceeds force of incoming steam and low pressure area under the disc... and immediately forces it down, closing the inlet. As condensation decreases the pressure in chamber "F", the disc rises and steps 1 or 2 repeat.

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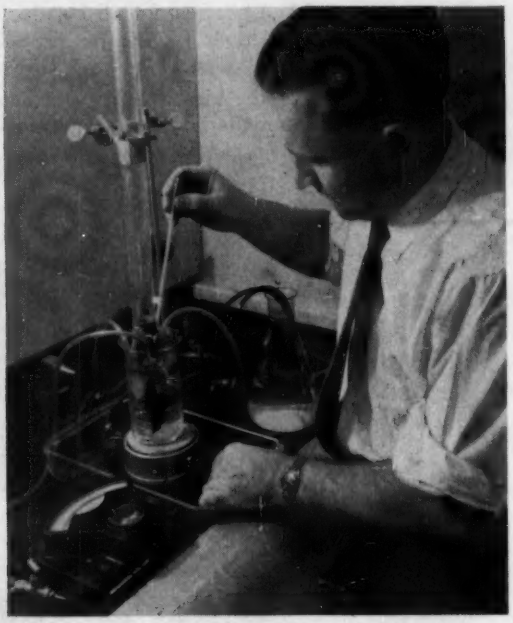
REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 236

Electroluminescence and fuel cell research moves ahead at new laboratories

Electroluminescent source bows in...



while researchers study fuel cell

► PULL a rabbit out of a hat—that's magic; pull light and auxiliary power for an industrial plant out of cells and that's science. According to spokesmen for two recently opened research centers, the latter projects are moving swiftly from the realm of the possible to the world of the practical.

The fuel cell, a battery that produces electricity from such gases as hydrogen and oxygen, is one of the many new devices under study at the new Parma, Ohio, basic research laboratories of National Carbon Co, a division of Union Carbide and Carbon Corporation.

Electroluminescence is a subject of study at Westinghouse Electric Corp's center in Churchill Borough, ten miles east of downtown Pittsburgh.

Neither project is new—the phenomenon of electroluminescence was discovered in 1936 by Georges Destriau, French scientist and Westinghouse lamp division consultant. Discovery of the fuel cell was announced in the BEAMA *Journal*, Jan 1954 (see POWER, April 1954). What *is* new is the prospect that in the very near future both may be economically feasible.

(*Continued on page* 234)

Power for Red China

(*McGraw - Hill World News*) Red China is to get a large number of railroad mounted electric power plants from East Germany. The small units are to have a capacity of 1000 kw.

Red China has, till now, gotten small package power plants exclusively from Czechoslovakia. Western experts in Central Europe feel that the shortage of iron and steel in Czechoslovakia may well have been a contributing factor in the re-orientation.

France and Britain to share electricity by underwater cable

Paris (McGraw-Hill World News)—The problem of how to tie in a simple and cheap system between the electricity networks of France and Britain has stumped engineers on both sides of the Channel for over a decade. Recently, state electric authorities in Paris and London jointly announced they had finally solved the technical puzzle. Work on an underwater dc cable will begin early next year and barring a last minute hitch, by 1960, Londoners may be lighting their homes by electric power generated in the French Alps. Tests to date back up this hope.

Basic idea behind the plan is that peak demands occur at different hours in the two countries and even at different times of the year. Thus when Britishers are overtaxing their national network, French generating equipment is under-employed. To take the strain off their system, British authorities under proposed scheme will plug in their network to the French system and soak up idle power. When the French system is under strain, and British demands are lighter, a reverse swapping of power will take place.

(*Continued on page* 234)

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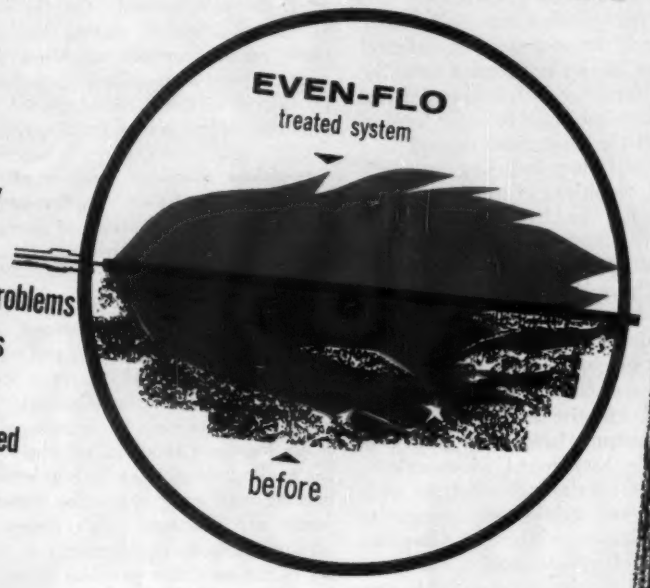

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TECHNICAL BRIEFS

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22 Papers for you on
GENERATORS
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Generators

Physical effects of thermal cycling on stator coil insulation of turbine generators. *By J S Johnson and J C Botts, Westinghouse Electric Corp.*

Laboratory studies and field experience have demonstrated an inherent limitation of asphalt-bonded mica insulation for large hydrogen-cooled machines when subjected to cyclic loading. Extent of the separations depend on a number of factors including machine's size and conditions of use.

Inspection and testing techniques have been developed to permit a reliable estimate of insulation conditions of units in service. Periodic inspection in connection with a regularly scheduled maintenance and inspection program is adequate to follow the conditions of a machine. When repairs are indicated, effective and expeditious repair techniques have been developed. An ample background of experience with coils repaired demonstrate their adequacy and stability with respect to further migration. Where a widespread condition of tape separation exists, replacement of the winding with new coils is indicated. *AIEE paper No. 56-5.*

Testing of main turbine-generator insulation. *By J E Mulavey, The Detroit Edison Co.*

The problem of evaluating the condition of generator insulation appears to be general throughout the industry. This paper deals with what one company is doing about it. Before relating recent experience with direct high-voltage testing, a short history of other methods is given.

For many years an insulation test with a megger was relied upon. Experience proved it to be a sensitive detector of moisture, and when a historical record of insulation resistance and temperature was accumulated for each piece of equipment, this test provided a relatively simple criterion of the condition of insulation. Later, the absorption test was added along with the polarization index feature.

In recent years the situation has become more critical. Where, formerly, turbine obsolescence removed from service old windings before they had worn out, now many main units with insulation 30-yr old are still in use. The success others reported with direct high-voltage testing led to an investigation of the possibilities of this relatively new method. On the basis of results obtained during the past three years, four old machines have been rewound and ten have been cleared for further service. One of the ten was repaired. *AIEE paper No 56-51.*

Gap-pickup conductor cooling of turbine-generator fields: ventilation arrangements and analysis of performance. *By D M Willyoung, General Electric Co.*

The gap-pickup, conductor-cooled field design utilizes gas scooped from the gap between the rotor and stator and circulated through passages in the conductors to cool the windings. Because this gas can be introduced at many locations axially along the rotor, the cooling circuits can be highly interspersed, and many ventilation arrangements are available. This paper describes the analysis and results of studies of the heat flow problem presented by these ventilation arrangements.

A digital computer has been used to obtain winding temperatures for any set of conductor dimensions or ventilation pattern. The speed, accuracy, completeness and convenience of this approach provides the designer with detailed temperature information allowing him to select the best design for each application. *AIEE paper No. 56-53.*

Liquid cooling of turbine-generator armature windings. *By C E Kilbourne and C H Holley, General Electric Co.*

This paper presents an account of the development of liquid-cooling for turbine-generator armature windings, including the solution of various detail problems which have arisen in the course of perfecting this new cooling method. Using liquid-cooling, the heat generated by losses in the armature conductors is removed from the winding by the flow of liquid either through passages in the conductors themselves, or through auxiliary passages built into the winding for this purpose. *AIEE paper No. 56-191.*

Electrical

Introduction of hydraulic operation to low-voltage air circuit breakers. *By H L Peek and M G Dyer, Allis-Chalmers Manufacturing Co.*

The designer of low-voltage switchgear is continually confronted by two conflicting demands: (1) the requirement for reducing the space occupied by the switchgear and (2) the requirement for increasing the interrupting capacity of the breakers which must be installed in allotted space of the switchgear enclosures. This paper describes design and development of a simple and unique hydraulic system which has been coordinated with a time-tested and proven mechanically trip-free linkage. The arrangement is adapted to fulfill the requirements imposed by the extremely arduous load characteristics of low-voltage high-current interrupting capacity air-circuit breakers. *AIEE paper No. 56-52.*

Application of polyethylene-insulated high voltage power cable in chemical plants. *By S J Rosch, Anaconda Wire & Cable Co.*

It is obviously impossible for a cable manufacturer to have investigated, in his laboratories, the effect of every type of chemical influence on a given material such as polyethylene. The author has, therefore, reviewed a substantial amount of the technical and trade literature of possible interest to the subject. Data on actual installations in chemical plants, plus some data accumulated in the laboratories of the company with which he is associated, is included, forming a fairly comprehensive survey dealing with possible merits of using polyethylene-insulated, high-voltage cables in chemicals and allied plants. *AIEE paper No. 56-71.*

Interruption tests on high-voltage air-break contactor. *By C A Lister, Electric Controller & Manufacturing Co.*

High-voltage air-break contactors are frequently used in controllers, both for starting motors and for interrupting short-circuits. According to NEMA Standards, 2300-4600-v contactors for this duty may be used in circuit locations where the available symmetrical

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Made by an exclusive J-M process, Interlocked packing is braided from tough long-fibre asbestos yarns strongly interlocked in a solid integral structure. There are no jackets to wear through . . . no plaits to loosen. That's why it retains its strength and efficiency far longer than other types.

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More TECHNICAL BRIEFS

Begins on page 158

short-circuit kva is as high as 50,000 kva. This paper describes new contactors designed for this service, discusses the tests made to prove the interrupting rating. *AIEE paper No. 56-31.*

Analysis of electric circuits containing nonlinear resistance. *By L A Pipes, University of California.*

This paper presents methods for the transient and steady-state analysis of electric circuits containing nonlinear resistances. It shows how the "reversion method" for the solution of nonlinear differential equations may be applied to determine the transient response of circuits containing nonlinear resistors. A method for the determination of the steady-state response of such circuits is also described. For purposes of illustration, the methods proposed are applied to the analysis of a circuit containing a linear inductor in series with a non-linear resistor. *AIEE paper No. 56-117.*

Properties of a dc arc in a magnetic field. *By L P Winsor, Rensselaer Polytechnic Institute, and T H Lee, General Electric Co.*

Magnetic fields are used extensively in practice to help control the position or motion of an electric arc. Properly applied, they can be used as an aid to either the stabilization or extinction of an arc. Improperly controlled, they may introduce unwanted instability to an arc.

Despite the wide application of magnetic fields to electric arcs, there is little knowledge of the fundamental behavior and mechanism of the motion of an arc in a magnetic field. This paper describes the behavior of direct-current arcs, at atmospheric pressure with currents up to 100 amperes, when subjected to uniform magnetic fields up to 200 gauss. Electrodes studied include silver, copper, aluminum, carbon, tungsten, molybdenum, nickel and titanium. *AIEE paper No. 56-132.*

Let-go currents and voltages. *By C F Dalziel, University of California, and F P Massoglia, San Francisco Naval Shipyard.*

An understanding of let-go currents and voltages is important. A person can withstand repeated exposure to his let-go value with no ill after-affects, at least for the time required for releasing his grasp of an energized conductor. Let-go current curves are presented for commercial 60-cycle alternating current, and for direct-current. New data is presented which confirms previously published let-go current curves for direct-currents having various amounts of ac ripple content. New data is given for 60-cycle alternating current let-go voltages. The voltage analysis is extended to cover direct-current, thus rounding out subject of let-go hazards. *AIEE paper No. 56-111.*

Influence of atmospheric water vapor on high-current dc arcs. *By R H Benner II, Consultant, and T B Jones, The Johns Hopkins University.*

To determine the effect of water vapor on arc characteristics, arcs with direct-currents in the range from 20 to 200 amperes were studied at atmospheric pressure in air containing water-vapor in controlled quantities. The water-vapor content of the air was varied from 0.15 to 100 percent by volume and this range of values constituted conditions from extremely dry air to saturated steam. For arc-electrodes the materials employed were iron, copper, tungsten and graphite. Data was taken relating the electrical characteristics and stability of the arc to atmospheric water-vapor content, arc-current, and electrode separation and material. It was found that the presence of water-vapor causes an increase in arc-voltage compared to the arc-voltage for dry air. This increase is much greater for the electrode materials iron and copper than for tungsten, graphite. *AIEE paper No. 56-109.*

Hydro

A new approach to forecasting daily peak loads. *By D K A Gillies, B Bernholtz and P J Sandiford, The Hydro-Electric Power Company of Ontario.*

Effect of weather elements on public-utility system peak demand is a major concern of load schedulers and power supervisors. For example, in the Southern Ontario System of Ontario Hydro, dark days with rainy weather in the spring and fall cause daily peak to increase by as much as 175 megawatts or 6½%. Fluctuations due to weather are superimposed on other fluctuations such as those attributable to the day of the week and work schedules of large consumers. All these effects combine to produce day-to-day variations as large as 8%. Consequently, load schedulers need a forecasting system that accurately predicts, twenty-four or more hours in advance, the generation required to meet these changing peak demands.

A good forecasting system makes it possible to reduce the spinning reserve which in turn results in a substantial economic gain. During periods of low-water flow and storage, a daily forecasting system which accounts quantitatively for weather effects is an important tool in determining the most economical scheduling of combined hydro and thermal power. For periods longer than twenty-four hours, a knowledge of weather's effect on peak demand is useful in predicting the largest and smallest peaks that may occur. These predictions will depend on the accuracy of the estimates of system growth (trend). If the weather effect can be separated from past data, it allows weather-free (presumably more accurate) trend figures to be calculated. *AIEE paper No. 56-158.*

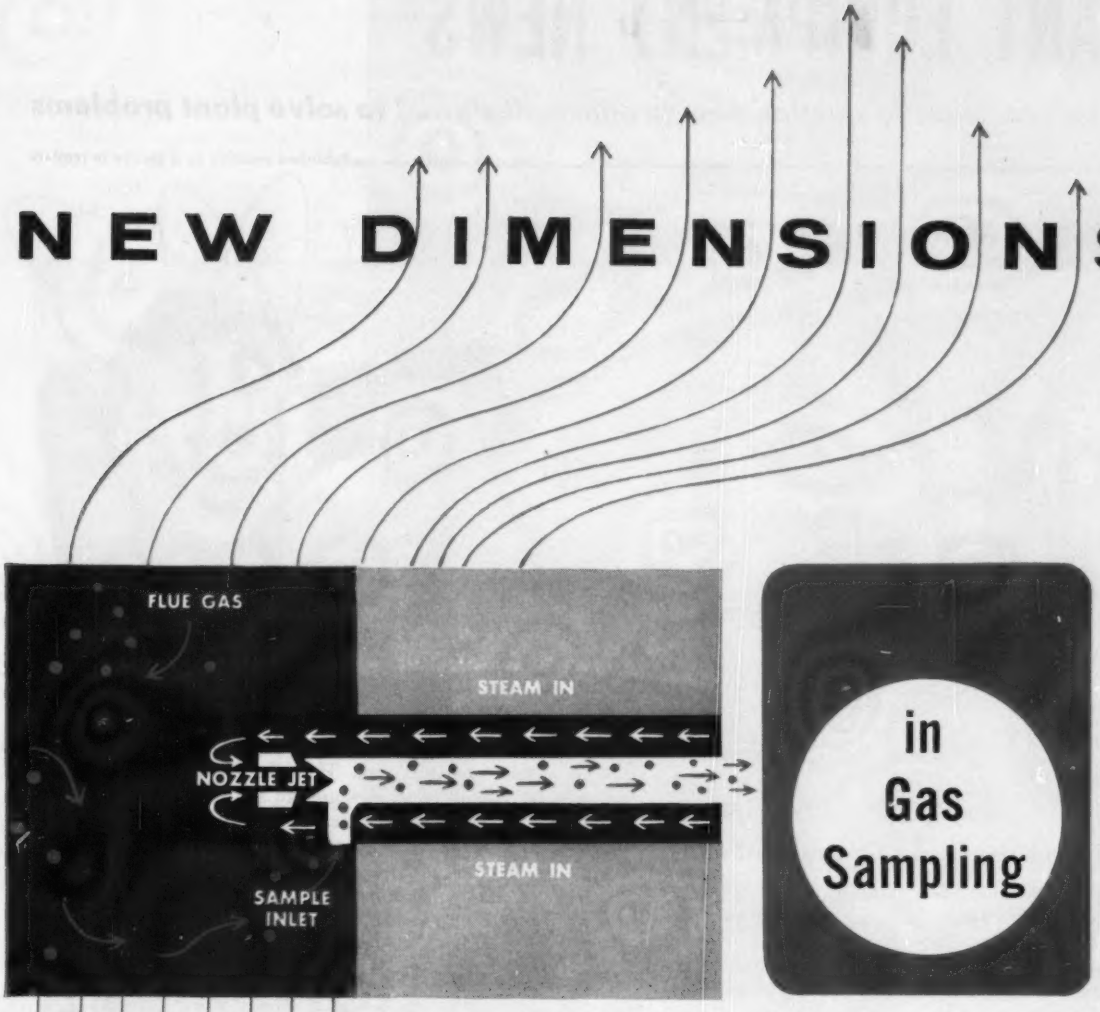
Underground hydroelectric stations—economic justifications. *By Adolph J Ackerman, Consulting Engineer, Madison, Wisconsin.*

Underground hydroelectric power stations have become an active topic of discussion in this country during the past decade. The majority of such stations have been constructed in Europe, but some of the pre-war European publications which carried descriptions of the earlier projects received relatively little attention in the U.S. because this type of development was not regarded as applicable to our local conditions. During the post-war period the impact of accelerated development of hydroelectric power in various parts of the world, and resulting publicity, has brought the underground power station into greater prominence. The concurrent publicity in other fields of technological development has, however, caused the underground power station to become incorrectly identified as a *new* development in the hydroelectric field.

This paper demonstrates that the underground power station is an old principle which, under present-day circumstances, offers a good solution—and can be economically justified—for certain special conditions. It takes place along with other forms of hydroelectric development, but, in general it is not a substitute for the conventional type of development in this country. In other words, proper choice of an

(*Continued on page* 220)

NEW DIMENSIONS



NEW SAMPLING SYSTEM OPERATES ON STEAM!

The new Hays Gaspirator* System is designed especially for difficult gas sampling problems involving high dust loading and high temperatures. It now permits accurate O_2 measurement, previously impossible in many applications.

This gas sampling system uses steam to obtain a continuous, clean sample. Suction which is created by the jet nozzle draws the sample in, where it is mixed with the steam. The steam is then condensed. Condensate and entrained solids drop down, and the sample is forced through the analyzer under pressure.

Hays, in the field of gas analysis for more than fifty years, developed the Gaspirator for use with their Magno-Therm Analyzer.

This analyzer, which operates on the paramagnetic principle, has for years been accepted as the leader in the field of O_2 measurement. Hundreds of companies are using the Magno-Therm and Hays electronic recorders very successfully in boiler plants and on process furnaces as a combustion guide, in regeneration of catalysts in refineries and in many other process applications.

For further details write for Bulletin 55-829-56.

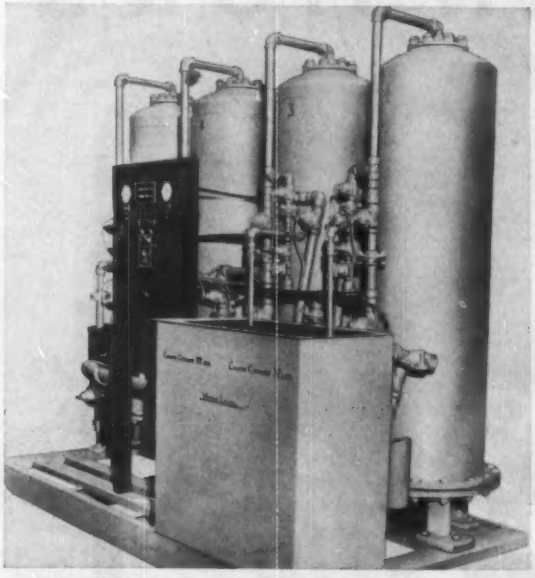
*Patents pending.

THE hays CORPORATION
MICHIGAN CITY 3, INDIANA

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Demineralizer works on multicolumns

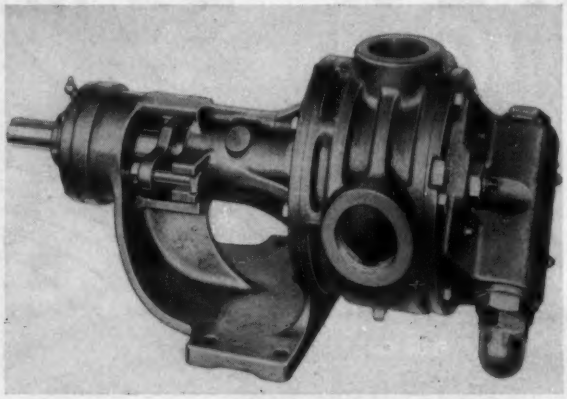
1101 • Fully automatic demineralizer, which operates on multicolumn ion-exchange principles, passes raw water through four columns: two each, alternately, of cation and anion resins. Third and fourth columns remove more weakly ionized impurities that may have passed through first cation and anion columns. Thus, effective removal of free CO_2 and silica is accomplished and an effluent of exceptionally high purity is provided, according to manufacturer.

All operating functions are automatic. When effluent's purity falls below desired standard originally set by operator, unit automatically stops delivering treated water and need for a regeneration cycle is signalled. Regeneration cycle is initiated by setting one switch and completes itself entirely automatically, including rinsing and recutting in the effluent when reset standard of purity is attained.

Columns of *LA-1000* unit are rolled steel, butt welded, 100% plastic lines. Underdrain system consists of perforated stainless-steel plate on top of which a plastic screen rests. According to manufacturer this system produces excellent distribution results and eliminates necessity of space-consuming distribution media.

Regenerant piping includes non-corrosive eductors, non-corrosive valves, and plastic draw-up lines for both acid and caustic regenerants. Process piping is 150-lb bronze pipe for all raw-water lines, stainless steel or plastic on all effluent lines. Request full info from manufacturer.

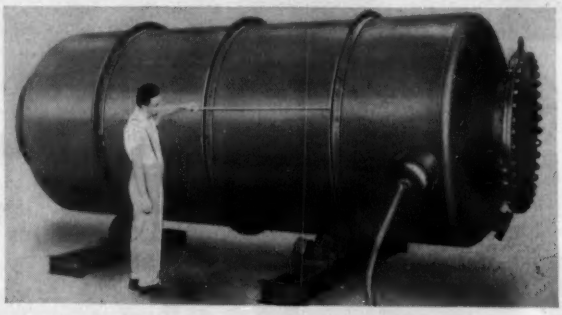
Penfield Mfg Co, 19 High School Ave, Meriden, Conn.



Ready five new series of rotary pumps

1102 • Standard-duty pumps, *Series A*, consist of ten basic sizes from 3 to over 100-gpm capacities in two speed ranges up to 650 and 1800 rpm. Units handle liquids of light to medium viscosities at pressures to 125 psi. *Series B* pumps are suited for handling hazardous liquids. *Series C* group handles heavy-duty applications. *Series D* units handle l-p gases. Medium- to high-viscosity materials utilize the steam-jacketed *Series E* group. Details from manufacturer.

Wayne Pump Co, 112 Tecumseh St, Fort Wayne, Ind.

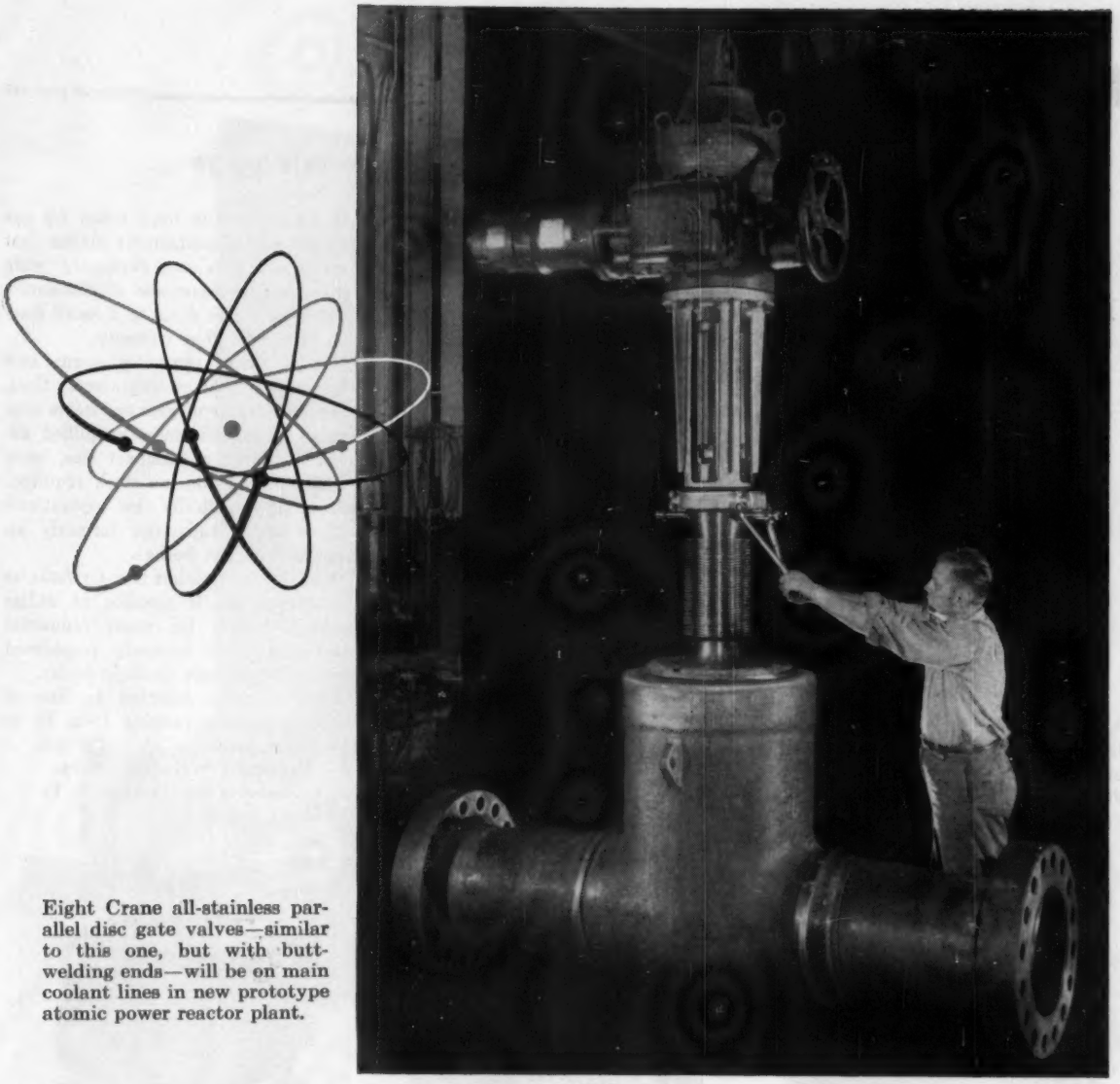


Purifier conserves water and steam

1103 • Unit is installed in low-pressure steam lines on exhaust side to remove oil, pipe scale and other impurities so that steam can be returned to boiler. This action is said to reduce amount of raw feedwater required for boiler. Manufacturer also claims that it cuts steam cost since condensed water is less costly to generate into steam than raw water. Condensate from purified steam also lessens danger of boiler hot-spots. Unit cleans steam without using moving parts, filters or mesh screens. It operates on two-stage principle of separation and is made in a wide range of sizes.

V D Anderson Co, 1935 W 96th St, Cleveland 2, Ohio

For more data on these items, use post cards page 171. Identify your request with item number.



Eight Crane all-stainless parallel disc gate valves—similar to this one, but with butt-welding ends—will be on main coolant lines in new prototype atomic power reactor plant.

AGAIN... Crane leads the way in flow control for atomic power

As the age of atomic power unfolds and expands, Crane continues to lead the way in flow control.

Crane equipment is already playing an important role in the mighty *Nautilus* and *Seawolf*—the Navy's celebrated atomic-powered submarines.

Now Crane valves are ready to make history again in the peaceful use of atomic energy—in the nation's first land-based atomic power plant.

Eight Crane stainless steel gate valves—similar to the one shown above—will be on the main coolant lines in the pressurized water reactor. Crane's broad experience in flow control for atomic power—dating from the beginning of this radically different field—assures low-cost, dependable service on this critical application.

Whether your future involves atomic energy for power or radioactive materials for processing—call on Crane for the right valves and fittings. You'll find Crane has the depth in research, engineering, and manufacturing abilities and facilities you're looking for.

CRANE VALVES & FITTINGS

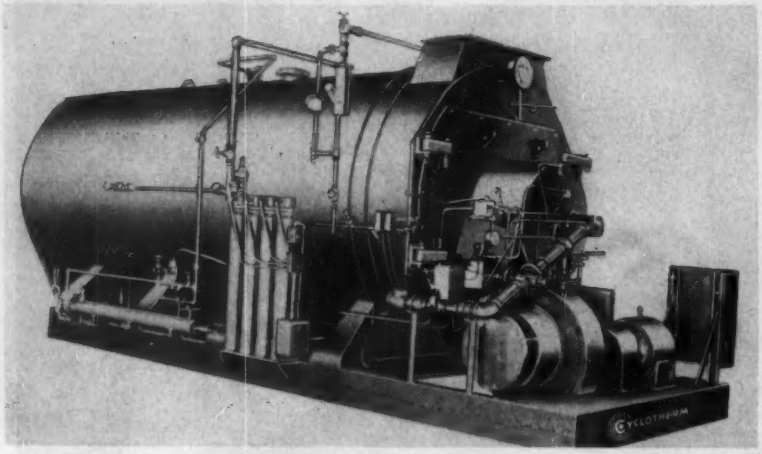
PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 162

Need a boiler in your business? Check this page



Package generator breaks capacity records

1106 • Package steam generator delivers 26,000 lb of steam per hour at over 80% efficiency. It is said to be the highest capacity firetube boiler manufactured since establishment of the package-boiler industry in 1935.

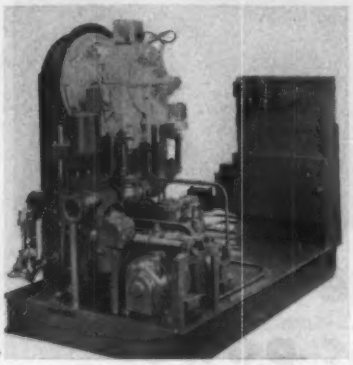
Overall dimensions are 28x9½x10¾ ft. Designed for heavy oil or gas, boiler can be adapted to burn either l-p gas or light oil. Manufacturer claims that modulation over an extremely wide range permits guarantee of efficiencies of 80% or better down to a small fraction of rated 750-hp capacity.

Husky steam generator opens new prospects for plant engineers. Combines advantages of package steam generators (high efficiency, simplified automatic operation, compact size, inexpensive installation, no stack required, unified responsibility for operation) with steaming capacities formerly associated with hrt boilers.

Manufacturer claims that *Cyclotherm C-26,000* makes it possible to utilize package boilers for many industrial processing loads formerly considered too big for a single package boiler.

Unit is latest addition to line of steam generators ranging from 18 to 750 hp, at pressures up to 200 psi.

National-U.S. Radiator Corp, Cyclotherm Div, Oswego, N. Y.



Combustion assemblies

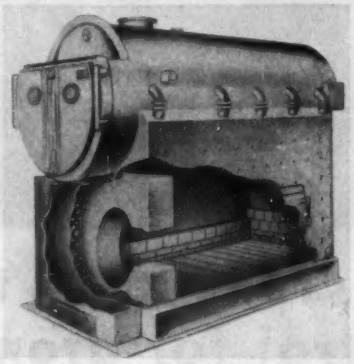
1107 • Packaged combustion assemblies, utilizing gas, oil or gas-oil firing, can be used to modernize or convert existing boiler or processing units.

Unit includes burner, automatic controls, forced-draft air supply, full modulation firing control, ignition, complete piping and wiring, and refractory required for burner throat.

Unit may be used on furnaces, ovens, vats, kilns, dryers, boilers and other types of industrial heat exchangers. Manufacturer states that various combinations of assemblies are available.

Unit comes in five sizes ranging from 3 to 25-million Btu per hour.

Orr & Sembower, Inc, Reading, Pa.



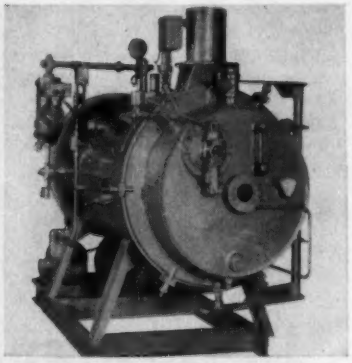
Oil-firing boilers

1108 • Line of 18 steel boilers for oil firing has advantages of firebox boilers, plus low water line and minimum space requirements.

Unit is suited for installations requiring a SBI low-pressure steam rating of from 4250 to 60,710 sq ft; SBI water rating of 6800 to 97,140 sq ft.

According to manufacturer, zone of combustion is moved up into firebox. Manufacturer also claims that sufficient refractory combustion chamber can be installed so that well-known makes of oil burners can operate on any grade of oil efficiently. Request details.

Pacific Steel Boiler Div, National-U.S. Radiator Corp, Johnstown, Pa.



Packaged steam generator

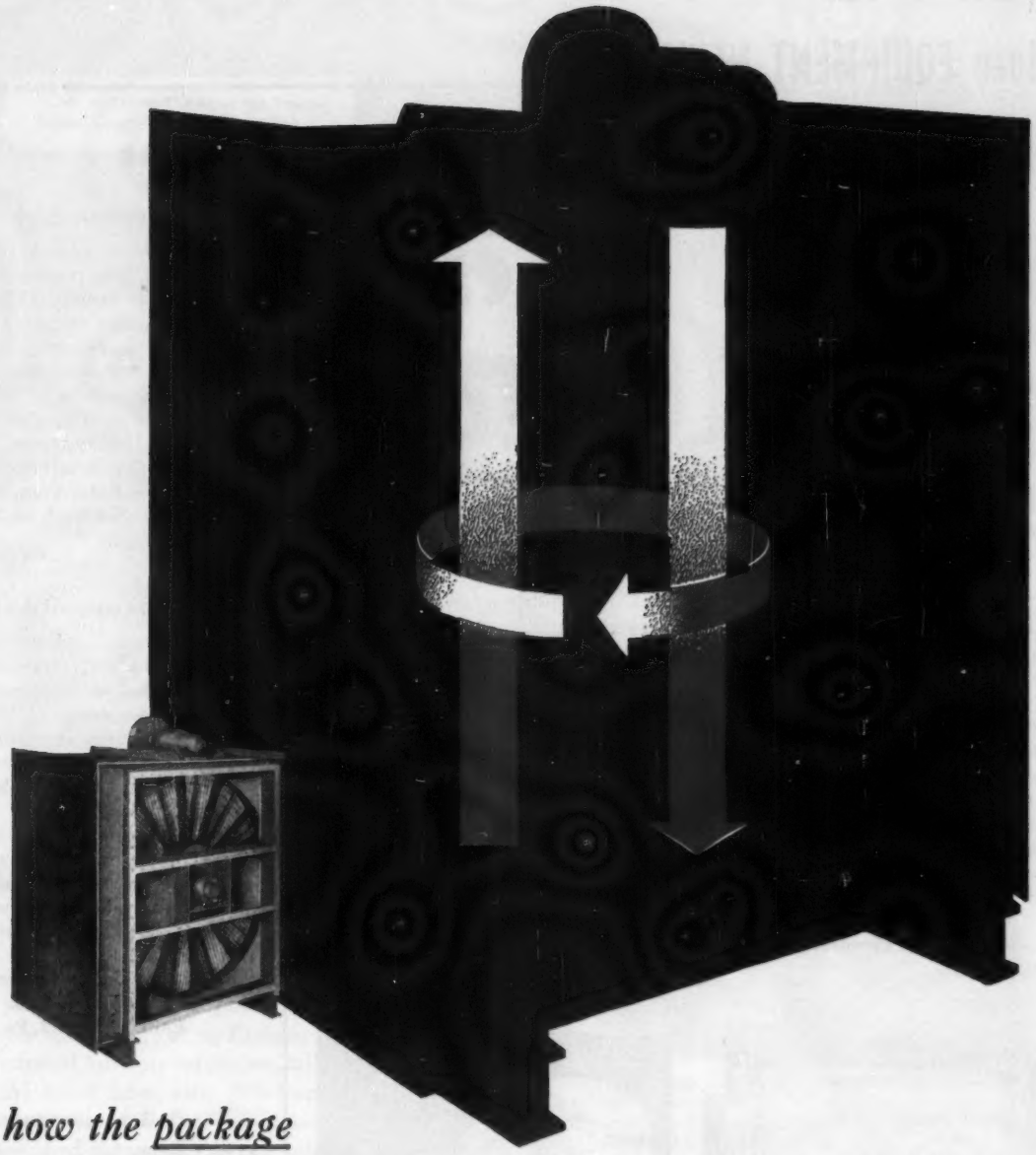
1109 • Packaged steam generator, 50 hp, for oil or gas firing has circular water chamber at rear head. "Wet back" does three things: (1) carries off excess heat, permitting operation at a higher boiler rating (2) provides a condensate receiver (3) preheats water that goes to boiler tubes.

It is said that water-cooled rear head makes it possible to fire a boiler size formerly rated at 30 to 50 hp.

Boiler contains under 100 sq ft of heating surface and slightly less than 3 sq ft of equivalent grate area. Unit may be fired by No. 3, 5 or 6 fuel oil and/or by manufactured or natural gas.

York Shipley, Inc, York, Pa.

For more data on these items, use post cards page 171. Identify your request with item number.



how the package

LJUNGSTROM® AIR PREHEATER

boosts small boiler performance . . .

Advantages of
The Package Ljungstrom Air Preheater

1. Reduces fuel consumption . . . even permits use of low grade fuels.
2. Increases boiler output and reliability.
3. Eliminates cold spots . . . keeps corrosion to a minimum.
4. Easy, fast to clean and maintain.
5. Comes fully assembled—ready to install.

The new, completely *shop-assembled* Package Ljungstrom Air Preheater means that boilers as small as 25,000 pounds of steam per hour can have the advantages of regenerative preheating using the same principle of heat recovery used by large, efficiency-minded utilities.

Here's what the Package Ljungstrom does for you: (1) It saves fuel—roughly 1% for every 45-50 F air preheat. (2) It boosts boiler output and efficiency substantially. (3) Ljungstrom permits use of lower grade fuels. All of which means better performance at lower cost. For more detailed information — get in touch with The Air Preheater Corporation, today. Free brochure on request.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

More EQUIPMENT NEWS

Begins on page 162

In the market for meters? Take a look at these

Portable oxygen analyzer

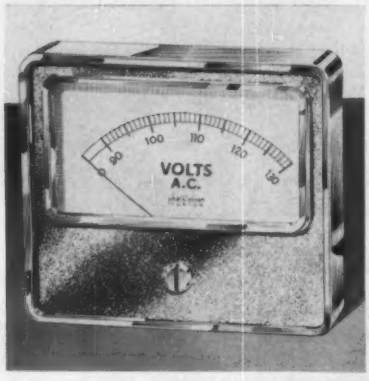
1110 • *Model D2* may be used to measure oxygen in almost any mixture of gases. Manufacturer states that accuracy of reading is not affected by other gases in the mixture. Operation consists of squeezing a bulb to draw sample into analyzer and pressing a switch. Oxygen concentration can be read instantly, according to manufacturer. Range is 0-25% O_2; accuracy ± 0.5% O_2. Unit is completely self-contained and portable. Details on request.

Arnold O Beckman, Inc, 1020 Mission St, S Pasadena, Calif.

Portable pyrometer

1111 • *Pyrotest 9B* checks and calibrates all types of industrial and laboratory temperature instruments. Unit has interchangeable direct-reading scales and may be used with six types of thermocouples. It has a set of nine scales, six for temperatures and three for millivolts. May be used for any temperature recorder, indicator or controller operating within a range of 32 F and 3215 F and using any type thermocouple. Request further details.

Technique Assoc, Inc, 211 E South St, Indianapolis, Ind.



Expanded-scale voltmeters

1112 • Meter, with expanded scale calibrated 90 to 130-v ac rms, was designed for line voltage measurements. Comes in nine case styles. Manufacturer claims that in many applications expanded scale will give up to ten times greater readibility on equipment. Units may be obtained in ac or dc and in a variety of ranges for specified requirements. Details from manufacturer.

Phaostron Instrument and Electric Co, 151 Pasadena Ave, S Pasadena, Calif.

Flow-rate indicator

1113 • Industrial logarithmic panel indicator is suited for use with turbine-type primary metering elements. Unit converts output signal of turbine meter into a series of pulses of constant amplitude at frequency equal to that of turbine meter output and, therefore proportional to volumetric flow rate. External terminals provide for pulse and dc millivolt output signals.

Fischer & Porter Co, 808 Jacksonville Rd, Hatboro, Pa.

Pressure gage

1114 • *Bandrive* gage is said to incorporate a new concept in transmitting linear motion. Deflection of the bourdon tube or pressure cell is transmitted to indicating pointer of gage without gears. Manufacturer claims that movement eliminates backlash and gives positive response to movement of pressure element. Patented spring is self-restoring.

Norden-Ketay Corp, 99 Park Ave, New York 16, N. Y.

Remote control device

1115 • Capacity telemeter measures level in storage tanks and bins located more than three-quarters of a mile away. Accuracy in gaging contents of a tank is unaffected by changes in weather conditions or electrical properties of cable, manufacturer states.

Although generally used in installations where tanks are scattered over a wide area, unit is said to be economically suited to some single-tank installations, particularly those that are hard to measure.

Robertshaw-Fulton Controls Co, 2920 N Fourth St, Philadelphia 33, Pa.

Boiler-water gage

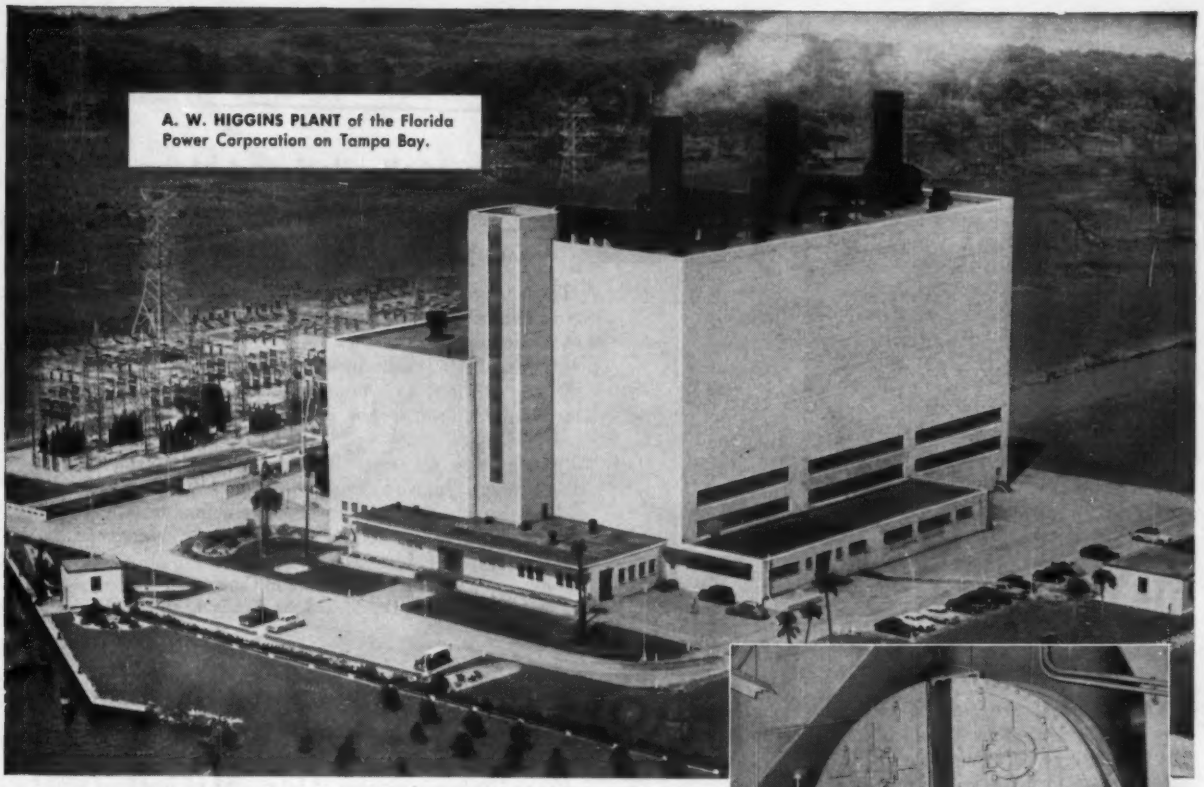
1116 • Gage has red and green readings and is designed for high-pressure boilers up to 3300 psi. In port-type openings water shows green, steam shows red. Thus full gage is all green, an empty gage all red.

Individual cover-glass assemblies permit quick and easy servicing of gage in place, without removal from boiler, according to manufacturer.

Large-diameter port openings are said to give increased visibility. Manufacturer states that a variety of mirrors bring lighted, head-on view of gage face to convenient operating floor locations.

Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

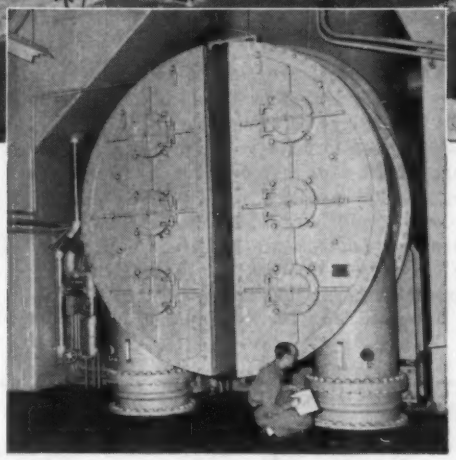
For details on these items use post cards p 171. Identify request with item number.



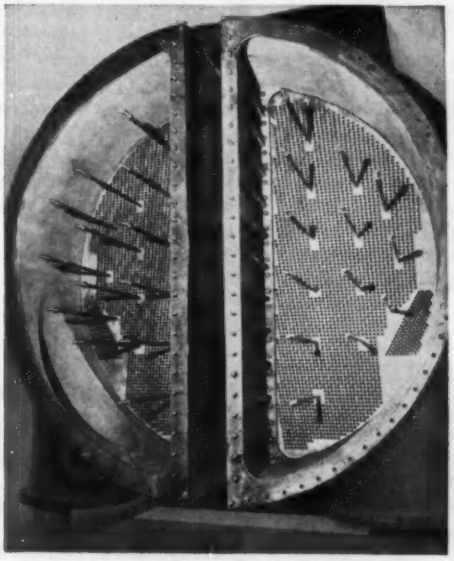
A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.

REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are 7/8" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

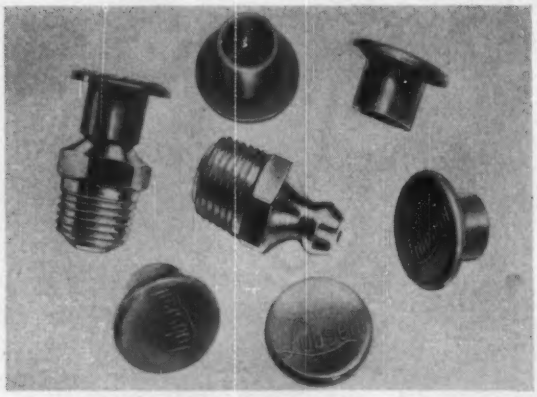
Mills: Maltimore, Md.; Brooklyn, N.Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

More EQUIPMENT NEWS

Begins on page 162

Smooth your path by keeping machinery well-oiled and clean



Seals keep grease fittings clean

1117 • *Lubseals* are said to provide a practical, economical solution to the problem of maintaining clean, dirt-free fittings between grease applications. They may also be used to mask grease fittings during spray painting. Plastic caps snap over any standard fitting, preventing harmful particles of dust, grit and abrasives from collecting and later being injected into bearings during greasing. *Lubseals* are available at $7.50 per thousand, in four colors. Colors act as flags, so that no fittings are passed up during lubrication, and as a color code.

Wilson Plastics, Inc, 1531 Milan Rd, Sandusky, Ohio

Compressor lubricant shaves fire risk

1118 • Synthetic lubricant for air compressors is said to minimize explosions and receiver fires as well as carbon deposits on exhaust valves and air-system piping.

Pydraul AC is described as a fire-resistant fluid, equivalent in lubricity to a premium-grade lube oil. According to manufacturer it has been tested by more than 30 companies.

Conversion of compressors to *Pydraul AC* is said to be simple. Splash-lubricated compressors need only be cleaned of their petroleum deposits before installing new fluid. Separate force-feed cylinder lubricators can be converted with modification kits.

Monsanto Chemical Company, 800 N 12th Boulevard, St. Louis 4, Missouri

Oil-mist lubricator works overtime

1119 • These oil-mist lubricators are designed to provide a "48-hour week" of continuous lubrication for up to 300 or 500 bearing-inches of lubricated mechanisms while consuming only one-tenth as much oil as other methods. System uses compressed air to atomize oil into mist which is then distributed through tubing to mechanisms requiring lubrication. Unit is said to operate equally well in compact installation or over a distance of 400 ft.

Stewart-Warner Corporation, 1826 Diversey Pkwy, Chicago 14, Illinois

For more data on these items, use post cards page 171. Identify your request with item number.

Oiler keeps constant level in reservoir

1120 • Oiler is said to maintain oil level automatically in a bearing reservoir, assuring top protection. Units can be used on ring-oiled and rolling bearings, gear boxes, pump housings and moistening pads.

Operation is based on the liquid-seal principle. When oil level in bearing recedes because of oil consumption, liquid seal on spout inside oiler is temporarily broken. This allows air from air intake to enter oiler reservoir, releasing oil until a seal and proper level is again restored.

Oiler is filled through a top filler cap. According to manufacturer, this simplifies replenishing of oil, prevents messy floors and loss of oil. It is said to save time and make it unnecessary to have extra bottles on hand. Shutoff has been provided which holds oil supply in reservoir when filler cap is removed. After filler cap is screwed down tightly, oiler will again resume normal functioning.

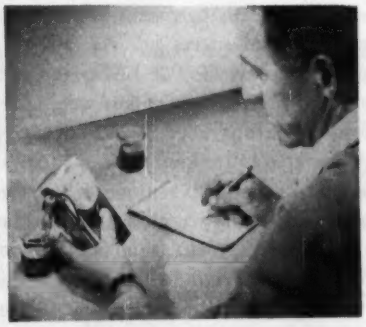
Oil-Rite Corp, 2317 Waldo Blvd, Manitowoc, Wisconsin

Conveyor lubricator easy to service

1121 • *100 Series* conveyor lubricator is said to include four improvements: (1) enclosure in aluminum housing (2) improved filters and regulators as standard equipment (3) redesigned trip mechanism that actuates valve through cam (4) provision for easy servicing. Catalog contains information on eight models.

J N Fauver Co, 51 West Hancock, Detroit, Michigan

Be sure to check this item . . .



Pocket size pH meter . . . . . p 176

. . . and these and the many others appearing on pages noted below:

Heavy fuel-oil heater pumps . . . . p 178
Portable belt conveyors . . . . . p 180
Ac-dc arc welder . . . . . p 182
Nylon conveyor fabric . . . . . p 184
Non-porous rubber . . . . . p 186
Pressure vacuum bleeder . . . . . p 188

ASCO
BULLETIN 8022—SAFETY SHUT OFF VALVE
TO OPEN—PUSH BUTTON ON HANDLE, MOVE TO FULL LEFT. IF CURRENT IS ON, VALVE WILL LATCH AND CAN BE OPENED BY MOVING HANDLE TO FULL RIGHT.
TO CLOSE—OPEN ELECTRICAL CIRCUIT OR PUSH BUTTON AND MOVE HANDLE TO FULL LEFT.
OPEN
Automatic Switch Co.

FM

Factory Mutual Approved

New ASCO SAFETY SHUT-OFF VALVE provides tight seating... large flow capacity

Important design features of this new ASCO valve — absolutely tight seating on gas — and large flow capacity — ideally suit it for use as a safety shut-off valve on gas and oil fired furnaces, ovens and boilers.

This new ASCO Solenoid Valve, Bulletin 8022, assures safe operation because its globe type seating, with integral crown type seat and soft composition disc, tightly seals off gas or oil. A unique combination — Y type body and oversize port (in 1¼"-3" sizes) provides flow almost equal to that of a "straight through" gate valve. Factory Mutual Laboratories has approved the Bulletin 8022 in 1¼"-3" sizes for handling manufactured, natural, and L-P gases in maximum ambient temperatures of 104° F. Valves can also be used for fuel oil and non-corrosive liquids and gases.

This free handle valve must be manually opened — it can only be opened and remain in the open latched position when the solenoid is energized. When the solenoid is de-energized, the valve will trip closed.

Important announcement . . . *new ASCO plant now being built in Florham Park, N. J. will double production capacity and greatly extend the range of our research, product development and services.*

- **Dependable Control by ASCO.**

  The ASCO Bulletin 8022 comes in sizes ¾" through 6", with pressures ranging from 25 to 150 p.s.i. It has been designed to permit mounting in any position. This eliminates piping problems that occur with valves that must be mounted in one position. Valves are available with general purpose, watertight or explosion-proof solenoid enclosures to meet any requirements.

  For further information, write for ASCO Bulletin 8022. Or call the ASCO Engineer. He can give you full data on this valve, and on ASCO's complete line of 2, 3, and 4 way solenoid valves.

- **Special Features**

  Auxiliary Switch for operation of controls and signals. Time Delay to prevent valve from closing on a momentary loss of power.

AUTOMATIC TRANSFER SWITCHES
SOLENOID VALVES ELECTROMAGNETIC CONTROL

Automatic Switch Co.

392B Lakeside Avenue, Orange, N. J. • ORange 2-5300

ASCO

Traveling Stocking and Reclaiming Coal Handling Tower OF WELDED DESIGN

a Mead-Morrison development

All connections in the main structure of this tower, both shop and field, are welded. The cantilevers employ riveted connections and are fastened to the main structure by means of rivets.

This modern design is typical of Mead-Morrison pioneering in developing stronger and more economical material-handling equipment. Write for complete information on Mead-Morrison Towers and Bridges for coal, ore and other materials.

Coal is brought to the plant of a large West Virginia steel mill in cars which dump into a digging pit alongside the Mead-Morrison tower. Unloading of the cars is aided by a car shakeout suspended from the side of the tower.

The tower digs coal from the trough and delivers it to the near-side stocking pile at the rated capacity of 915 tons per hour, and to the far-side stocking pile at the rated capacity of 610 tons per hour.

The tower also reclaims coal from the storage piles to the receiving hopper in the tower at the rated capacity of 765 tons per hour from either pile.

Included in the Mead-Morrison equipment are a 6½ ton light-weight grab bucket and automatic rail clamps to protect the structure in a high wind. Adjustable voltage is used for the hoist, close and trolley motions, and constant voltage for the propelling motors.

MEAD-MORRISON

Division of McKIERNAN-TERRY CORPORATION

MANUFACTURING ENGINEERS

Harrison, New Jersey • Plants at Harrison, N. J. and Dover, N. J.

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — *do not use manufacturer's bulletin number.* →

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

---

I want details on these New Products:

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This Month's FREE Literature

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330 West 42nd Street
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Reader Service Department
330 West 42nd Street
New York 36, N. Y.

BOILERS AND AUXILIARIES

1 **Grate type stoker** is described in 18-p illustrated catalog 562. Describes installations; lists typical heat balance table and tabulation showing dimensions of standard stokers. Johnson & Jennings Co, 6917 Bessemer Ave, Cleveland 27, Ohio.

2 **Power and heating** boilers are subject of 4-p illustrated bulletin B-3300-A. Includes ten models and ranges. Struthers Wells Corp, Titusville Iron Works Div, Titusville, Pa.

3 **Insulated stack** is described in 4-p illustrated folder 1S-28. Contains complete product information, including advantages and description. Also contains specs, suggested installation methods and test data. Van Packer Corp, Bettendorf, Iowa.

4 **Air setting cement** for incinerators, boilers and gas generators is subject of bulletin CP7.4. Describes how to mix and apply. Norton Co, 50 New Bond St, Worcester 6, Mass.

5 **Combustion control** is subject of 11-p illustrated bulletin. *Control fundamentals . . . their application to combustion.* Key components of combustion control systems are described in detail, with full explanations of their inter-relationship in operation of complete control system. Cleveland Fuel Co, 1111 Brookpark Rd, Cleveland 9, Ohio.

CONTROLS, ELECTRICAL & MECHANICAL

6 **Gas control** and automatic temperature control accessories are subject of Flip-Fact catalog. Operating characteristics, dimensions, test data, application instructions, methods of production and design advantages are included. A-P Controls Div, 2450 N 32nd St, Milwaukee 45, Wis.

7 **Unitized controls** are described in 4-p illustrated bulletin A-800. Contains cutaway and phantom views, schematic and dimensional sketches. The Swartwout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

8 **Temperature controller,** thermistor actuated, is subject of 4-p illustrated bulletin MC-133. Describes unit and thermistor sensing elements which permit control to 0.25%. Fenwal Inc, 113 Pleasant St, Ashland, Mass.

ELECTRICAL EQUIPMENT

9 **Dc motors,** ½ through 200 hp and motor-generator sets up through 200-kw output are described in bulletin 53B8424. Includes cutaway view of *(Continued on page 228)*

TRY THESE ADVANCED-DESIGN

STRONG STEAM TRAPS

...you'll never settle for anything less

tough — semi-steel, cast steel or forged steel construction takes hard usage . . . lasts a lifetime

trouble-free—all-stainless moving parts resist corrosion . . . slash maintenance costs

steam saving — dual-fulcrum inverted-bucket design heats equipment faster . . . keeps it hotter

efficient — unexcelled operation on high and low loads

priced right — cost no more than other leading traps . . . offer much more

- Strong Steam Traps are available in various sizes and capacities . . . from 0 to 2500 psi and to 1100°F. For complete details see your *Strong Distributor or write for Bulletin SS40C.*

50 years in steam specialties

STRONG, CARLISLE & HAMMOND COMPANY

1392 WEST 3rd STREET • CLEVELAND 13, OHIO

air traps • strainers • reducing valves • vacuum or pumping traps

continuous blowdown valves • separators • engine stops • F and T traps

George Edwards

presents the most powerful man in this country

► EACH SEPTEMBER our plant takes a day off for a picnic. The company takes over a small amusement park for its employees and their families and all rides are on the house. It's really a big day for the kids. They never get tired—and they never stop eating. They're perpetual motion machines with hollow legs.

A five-inning baseball game between "shop" and "office" is the highlight of the day for the men. Both sides play to win and any reverence for company brass goes out the window. For instance, Al Gentry, a machinist, slid into second to break up a double play and upset Ben Freeman, our vice-president, in as slick a style as you'd see it done anywhere. Then, when they got up, Ben helped Al knock the dust off his pants. At least that's the way it looked from where I sat.

After the game, some of us were sitting around and, as could be expected, the talk turned to politics. There was the normal amount of difference of opinion, but nobody had even raised his voice until Pete Kilmer, one of our salesmen, said:

"I get a bang out of you fellows talking as though your individual votes will make any difference. I wouldn't waste my time voting because I know that when the chips are down, the deals are made by the boys who pull the strings."

That did it. Little Elmer Fry, chief draftsman, and normally one of the quietest people you'd ever meet, sat up bristling. Though Elmer's no silver-tongued orator, I think you'll agree that he stated some truths that can't be repeated too often.

"Pete," he said, "I'm not a flag-waver and I don't have a boy that didn't come back from overseas, but I do know there are still places in the world today where you'd be afraid to say that.

"All you have to do is look around to see how wrong you are. This picnic, for instance, is a symbol of our way of life. And if you don't like something about your job you know you're free to squawk about it. And you know you're free to change jobs, live and work and plan for the future of your kids in any way you want.

"You're willing to sit back and enjoy all these things—but you're too dumb to see that if everybody felt the way you do, you wouldn't have 'em for long. And you'd be the first guy to holler if anybody tried to take 'em away from you.

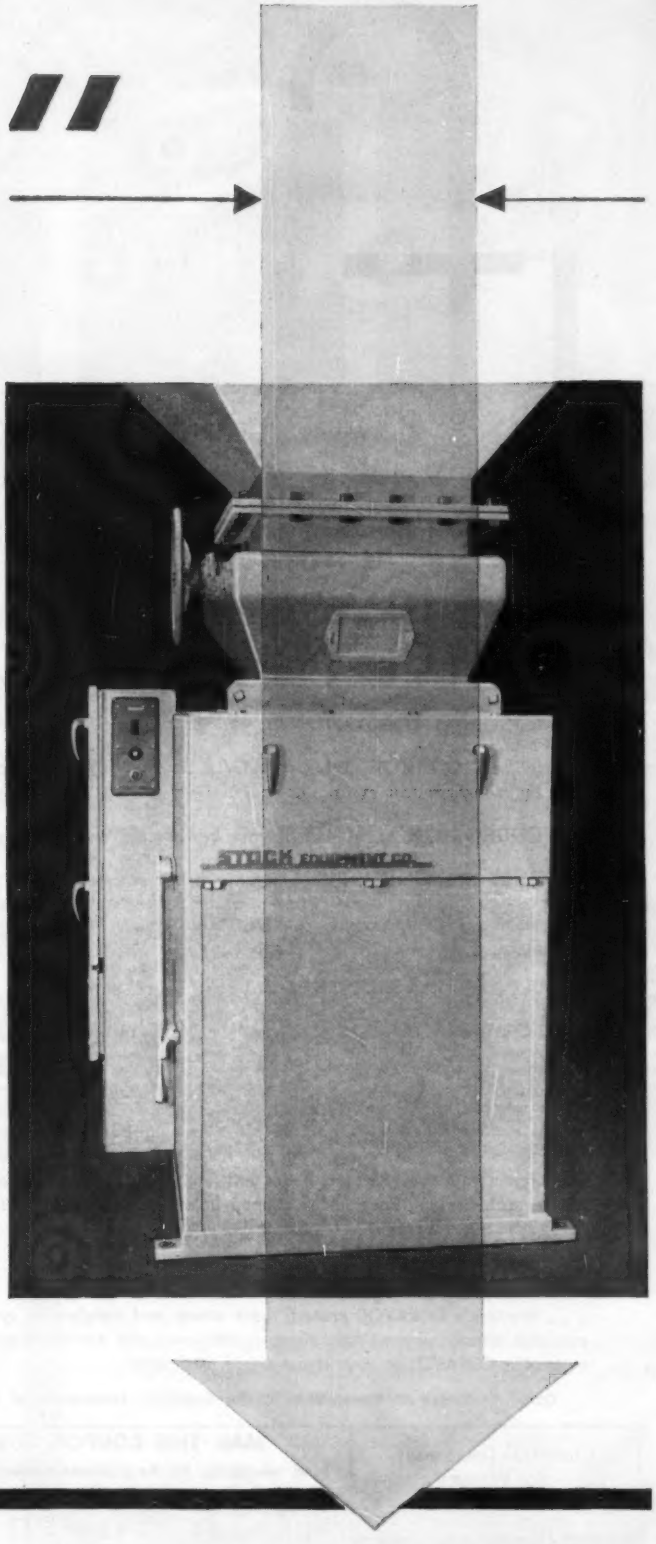
"If you don't use your right to vote because you don't believe it has any power, you might as well not believe in your right to give your kids a decent home, your right to go to church and all the rest of the things you just take for granted. Because if you *couldn't* vote as you pleased, or your vote *didn't* have power, you sure wouldn't have what you think of as your *rights*.

"A fellow can be a small frog in a mighty big puddle in everyday life, but when he steps up to mark that ballot, he's the most powerful man in this country."

24"

STRAIGHT THROUGH

No Restrictions . . .
No Baffles . . .
No Sloping Skirts



The *new* **S-E-Co. Model 50 Coal Scale** has been designed to eliminate coal stoppage difficulties. This scale makes it possible for you to get maximum accuracy of weight of coal burned for boiler tests, to keep inventory records, and to balance mills without danger of coal plugging and hanging up.

The inlet of the Model 50 is 24" inside square — the vertical feeder skirts carry a 24" stream of coal — and the stainless steel weigh hopper has a 24" wide outlet.

In addition, the large, rigid and well gasketed doors of the Model 50 maintain a clean installation that is easy to service. Roller bearings on the weigh hopper gate and other carefully worked out improvements make this scale of tomorrow the scale for you today.

SPECIALISTS IN
BUNKER TO PULVERIZER AND
BUNKER TO STOKER EQUIPMENT

STOCK Equipment Company

745-P HANNA BLDG., CLEVELAND 15, OHIO

if

you have any of these troubles:

1. **SCALE, CORROSION, or FOAMING** *in your boiler operation.*
2. * **RUST and CORROSION** *in your steam and condensate lines.*
3. **SCALE, CORROSION, or ALGAE GROWTH** *in your cooling or condenser water system.*
4. **CORROSION or SCALE** *in your hot or cold water tank and lines.*
5. **RUST and CORROSION** *in your brine or sweet water system.*
6. **SCALE** *in pumps, water jackets, compressors, coils, lines, or equipment.*
7. **SLUDGE and MOISTURE** *in your fuel oil supply.*
8. **SOOT DEPOSITS** *in your furnace combustion areas.*

then . . . let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam and fuel. Check the number or numbers of the problems you have in the coupon below. Get full information.

* for example

. . . Western's CORAVOL protects your steam and condensate system from corrosive attack; removes rust; increases efficiency and decreases maintenance costs. Put CORAVOL in your steam system and save!

Over 65 Years of Know-How In the Chemical Treatment of Water

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

713 Washington Street Kansas City 5, Missouri

MAIL THIS COUPON TODAY

Send information on the problems checked:

1 ☐ 2 ☐ 3 ☐ 4 ☐
5 ☐ 6 ☐ 7 ☐ 8 ☐

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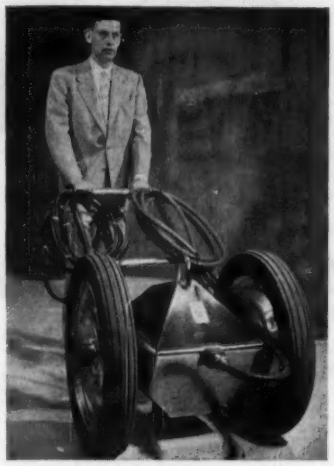
City_____ Zone_____ State_____

More EQUIPMENT NEWS

Begins on page 162



Isotope radiography machine

1126 • Unit employs radiation from 50-curie cobalt-60 source. May be used to detect possible defects in atomic-reactor shielding, flaws in castings, welded joints on boilers, pressure vessels, pipelines or any structure where strength is critical.

Capable of penetrating very heavy sections of steel, lead and other materials, unit is completely self-contained. It requires no power supply and can be wheeled readily by one man to any in-plant location or be taken out for field work.

The Budd Co, 2450 Hunting Park Ave, Philadelphia 32, Pa.

For more details on these items, use post cards p 171. Identify your request with item number.

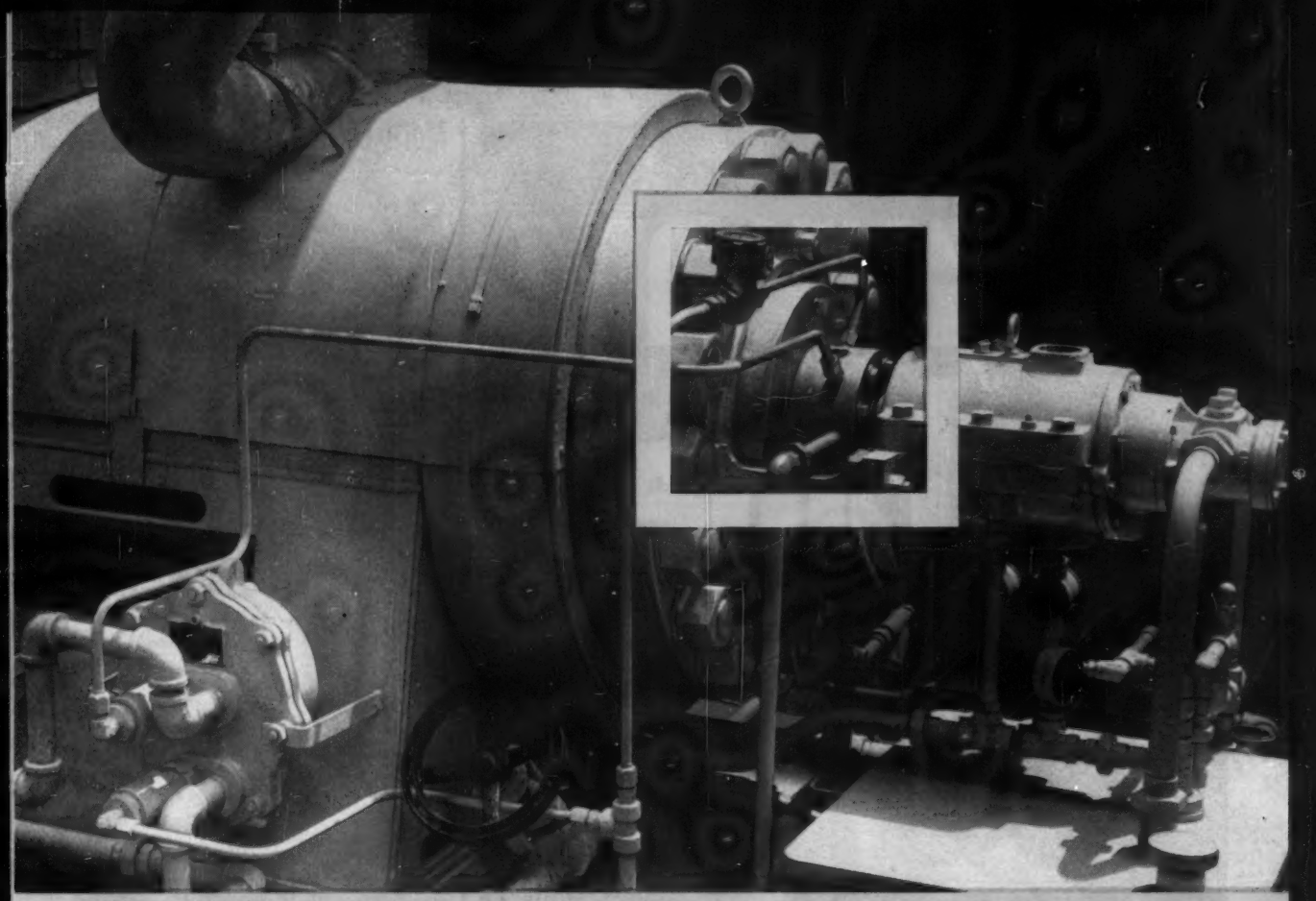
Pocket size pH meter

1131 • Meter measures acidity and alkalinity, uses a combination electrode. Battery-operated unit has range from 2 to 12 pH. The single electrode combines both reference and glass electrodes. Unit has memory dial for standardizing.

Beckman Instruments, Inc, 2500

Roof ventilator

1135 • Industrial roof ventilator features automatic damper blades. Manufacturer claims exhaust velocity keeps out rain, snow and exhaust reentry. Ventilator is said to be completely weather tight in closed position. (*Continued on page* 178)



City of Pasadena realizes

Big Savings on Boiler Feed with BJ Mechanical Seals

The City of Pasadena Light and Power Department has been using BJ Mechanical Seals in high temperature, high pressure boiler feed service for more than a year. These seals are installed on three double case boiler feed pumps with suction pressures to 400 psi, temperatures of 427° F. and an operating speed of 3550 rpm. The seals incorporate a pumping ring and small Graham Heliflow heat exchanger. Here are the results:

1. **SAVINGS ON MAINTENANCE**—Stuffingbox maintenance has been completely eliminated since installation of the seals. There has been no repacking labor cost... no pump shut-down loss.

2. **SAVINGS OF TREATED FEED WATER**—Previous to BJ Mechanical Seal installation, considerable loss of expensive, prepared feed water occurred. Now leakage loss is imperceptible.

3. **SAVINGS OF HEAT**—BTU's formerly lost through stuffingbox leakage are now sealed in for greater overall boiler feed operating efficiencies.

YOU CAN ACTUALLY COUNT THE SAVINGS IN LOWER COST OF KILOWATTS!

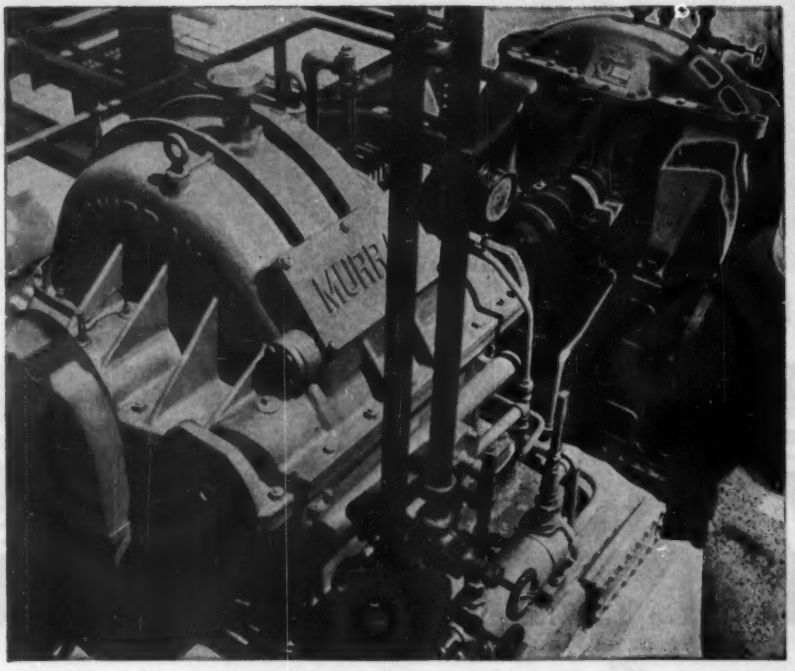
If you are operating high temperature, high pressure boiler feed pumps it will pay you to investigate now the big savings available from BJ Mechanical Seal installation.

Contact your BJ Pump Sales Engineer or write:

BYRON JACKSON PUMPS
INCORPORATED

A subsidiary of Borg-Warner Corporation
P.O. Box 2017A, Terminal Annex • Los Angeles 54, California

Murray Turbines



One of 4 Murray type U turbo-gear units installed in a southwest rubber plant still giving trouble free service after 12 years in an unprotected outdoor location. This unit drives an Induced Draft Fan requiring 425 HP at 683 RPM. The turbine speed is 3500 RPM.

● Murray turbo-gear units for mechanical drive are right at home in difficult outdoor installations. Fans, pumps, compressors, and many special types of slow speed machines are among the long list of installations powered by Murray turbo-gear units.

Murray gears are of the Herringbone or Double Helical type and all are pressure lubricated at the point of tooth contact.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

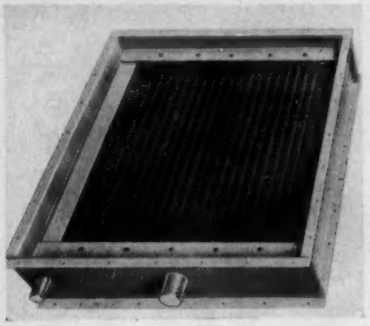
Builders of Steam Power Equipment for Three Quarters of a Century

More EQUIPMENT NEWS

Begins on page 162

Manufacturer claims that fan blades provide maximum thrust at lowest rpm's. Blade diameters range from 24 to 60 in. with exhaust capacities of 6640 to 53,700 cu ft per minute. Request full details.

Chicago Blower Corp, 9863 Pacific Ave, Franklin Park, Ill.

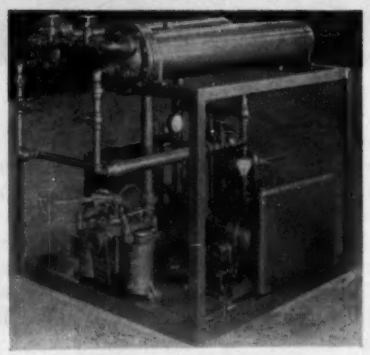


Steam coils

1130 • Heavy duty, distributor type steam coils have tilted feature to assure drainage of condensate, whether used for vertical or horizontal air flow, according to manufacturer. Cover pieces at header and stub ends are perforated to allow passage of measured amount of by-pass air, resulting in increased coil capacity according to manufacturer. Coils are pitched in casings to guarantee full drainage to condensate outlet. Unit is said to be designed so that every sq ft of face area produces equal heating capacity on full or modulated steam supply. Sizes range from 12 to 48 in. face height and from 24 to 120 in. width.

Rempe Co, 340 N Sacramento Blvd, Chicago, Ill.

For more details on these items, use post cards p 171. Identify your request with item number.



Heavy fuel-oil heater pumps

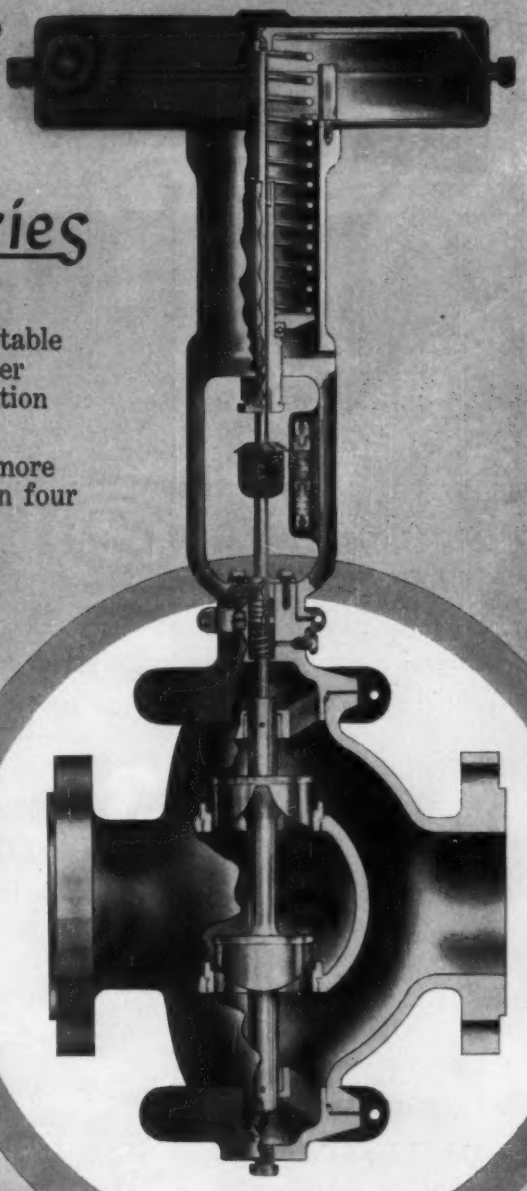
1127 • Packaged combinations for preheating, straining and pumping heavy No. 5, and Bunker-C fuel oils are available in duplex (photo) or single assemblies. Each set is a completely self-contained unit, ready for operation as soon as connections are made to fuel line and electrical service.

Manufactured for use with all burners designed to burn heavy oil, these pumps and preheater assemblies come in four

TAKE A GOOD LOOK...

...At The Redesigned Valve Body Of The New BS&B

Super 70 *series*



NEW — Streamlined flow contours provide more stable flow at all rated differentials and any inner valve position. Turbulence and cavitation are minimized.

NEW — Accurately engineered inner valves give more exacting flow characteristics. Available in four types, top and bottom guided.

NEW — Patented all-metal float ring seal provides positive self-actuating closure... tightens with the application of pressure.

NEW — Forged clamp ring allows yoke orientation to any position. Requires only two bolts... eliminates annoyance of gasket replacements.

Super "70" Series valve bodies are available in three styles... single port, double port and split body for use in erosive or corrosive fluid service where easy removability of valve seat is desirable. All bodies can be reversed without change of parts or special tools. Split and bolted stem connector is strong, easily accessible and quickly assembled. Bolted stuffing box assembly with stainless steel follower includes spring-compressed Teflon as standard packing. Steel bodied valve dimensions are in accordance with ASA Standards B 16.5—1953.

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

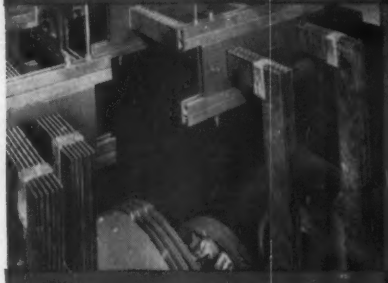
This advertisement highlights features of the Super "70" Series Valve Bodies only. Another will detail features of the Super "70" Series Topworks. Watch for it!

BLACK, SIVALLS & BRYSON, INC.
Controls Division, Dept. 4-Q11
7500 East 12th Street
Kansas City 26, Missouri

CADWELD
connections....
4 ways better

1 PERMANENT
Outlasts the conductor.

2 FULL LOAD CAPACITY
Greater current carrying capacity than the conductor.



3 CANNOT LOOSEN OR CORRODE
No bolts to maintain — uneffected by surge currents.

4 PORTABLE EQUIPMENT
Ideal for field work — requires no source of outside power.

CADWELD®

Erico Products, Inc.

2070 E. 61st Place Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

More EQUIPMENT NEWS

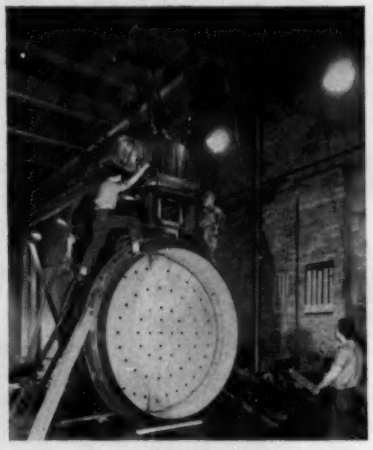
Begins on page 162

standard sizes: *Model 100*, pump size 2C, 100 gph; motor ½ hp; *Model 225*, pump size 3C, 225 gph. motor ¾ hp; *Model 400*, pump size 4C, 400 gph; motor 1 hp; *Model 700*, pump size 5C, 700 gph; motor 1½ hp.

Equipment for single assemblies includes oil preheater, duplex oil strainer, fuel pump, motor, pushbutton magnetic starter, pressure gage reading from 0 to 160 psi, ¾-in. relief valve, sheaves and belts, fan-type temperature gage, check valve and gate valve. Components are assembled and mounted on a steel base plate and frame. Aquastat and circulator for hot water or steam solenoid for steam are also furnished, but not mounted.

For duplex assemblies, two sets of most of the components listed above are provided. Request complete details.

York-Shipley, Inc, York, Pa.



Butterfly valve

1128 • Rubber seat butterfly valve is said to prevent severe cavitation at an expected flow rate of 800 cu ft per second. Disk of valve was designed to resemble "swiss-cheese" with 70, 1½ in. holes in downstream face. Hole through valve shaft and reducer output shaft connects disk interior with an air line to surface, and air at atmospheric pressure is supplied to downstream face of valve disk. This prevents formation of cavitation pockets produced by low pressure areas in water passing around valve disk, manufacturer states.

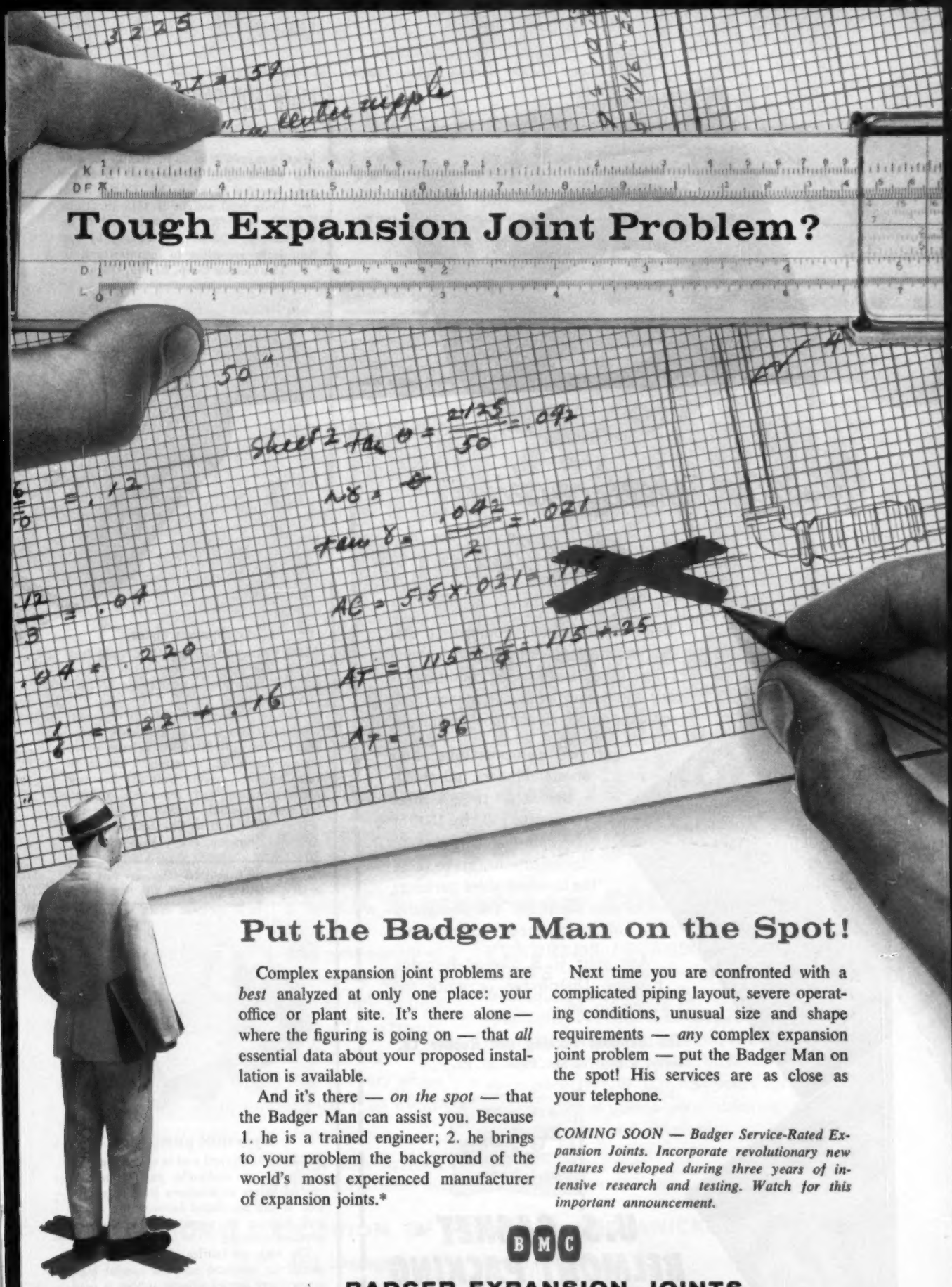
Henry Pratt Co, 2222 S Halsted, Chicago, Ill.

For more details on these items, use post cards p 171. Identify your request with item number.

Portable belt conveyors

1125 • Units are said to expand as much as 17 ft. Larger of two conveyors in line has distributed load capacity of 4000 lb with min length of 26 ft expandable to 43 ft. Belt, 16 in. wide, moves at speed of 78 ft per minute powered by a 2-hp, 220/60/3 motor. Unit's total weight is 5200 lb.

Small unit, which has total distributed weight capacity of 1000 lb, is 15 ft in



Put the Badger Man on the Spot!

Complex expansion joint problems are *best* analyzed at only one place: your office or plant site. It's there alone — where the figuring is going on — that *all* essential data about your proposed installation is available.

And it's there — *on the spot* — that the Badger Man can assist you. Because 1. he is a trained engineer; 2. he brings to your problem the background of the world's most experienced manufacturer of expansion joints.*

Next time you are confronted with a complicated piping layout, severe operating conditions, unusual size and shape requirements — *any* complex expansion joint problem — put the Badger Man on the spot! His services are as close as your telephone.

COMING SOON — Badger Service-Rated Expansion Joints. Incorporate revolutionary new features developed during three years of intensive research and testing. Watch for this important announcement.

Badger has been solving tough expansion joint problems for 50 years — a record unmatched by any other firm.

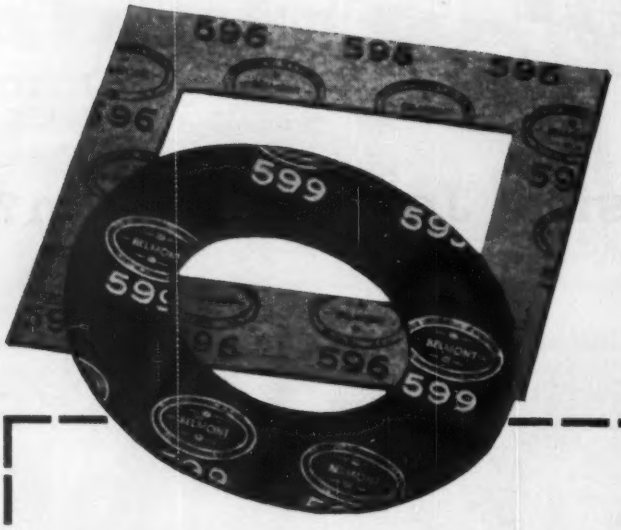
BMC

BADGER EXPANSION JOINTS

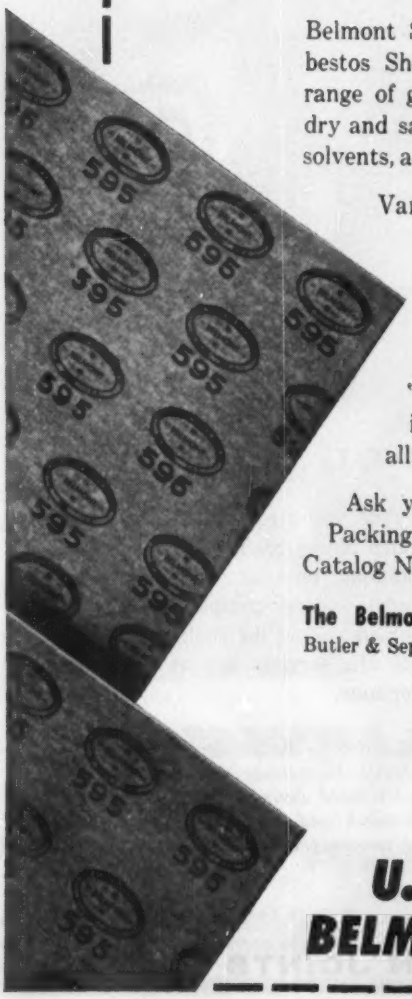
BADGER MANUFACTURING COMPANY

230 Bent Street, Cambridge 41, Massachusetts • 60 East 42nd Street, New York 17, New York

Representatives in principal cities



"handiest sheet packing in the plant"



Belmont Series 595 compressed Asbestos Sheet Packings meet a wide range of general service conditions—dry and saturated steam, air, gas, oil, solvents, ammonia and most chemicals.

Various compositions and special binders, all thicknesses 1/64" to 3/16", sheet sizes to 150" by 150" or supplied as cut gaskets to specifications, make these "the handiest sheet packings in the plant" for practically all maintenance requirements.

Ask your U. S. Gasket-Belmont Packing Distributor or write for Catalog No. 56.

The Belmont Packing and Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

U.S. GASKET • BELMONT PACKING

More EQUIPMENT NEWS

Begins on page 162

length expandable to 25 ft. Has 16 in. wide belt which moves at speed of 75 ft per min, powered by a one hp, 110/60/1 motor. Units total weight is 1515 lb. Units have six casters, 2 in. wide and 6 in. in diameter. Stability is assured by two floor locks according to manufacturer.

The Colson Corp, Elyria, Ohio

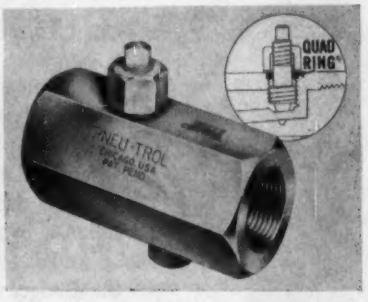
Ac-dc arc welder

1129 • Arc welder is an ac-dc and inert gas welder rated at 200 amps and 40 volts. Welder has current range of 10 to 300 amps, ac or dc.

Features include new case with removable side panels, recessed control panel and selector switch which permits operator to choose ac, dc straight, or dc reverse welding current. Unit also has magnetic contactor and removable rheostat for remote control. Details on request.

Hobart Bros Co, Hobart Square, Troy, Ohio

For more details on these items, use post cards p 171. Identify your request with item number.



Hydraulic pump seal

1132 • Four-lipped seal is said to perform effectively on hydraulic pumps and air control valves at pressures from 0 to 5000 psi. It can be placed between the needle and housing to prevent leakage during pressure variance.

The seals are fabricated from *366Y* compound for standard use; for special high-temperature service silicone rubber is used. They are said to have no parting line on

NEW POWER FACTS
AT YOUR FINGERTIPS

at the

22nd NATIONAL EXPOSITION of POWER & MECHANICAL ENGINEERING

Under auspices of ASME

NOV. 26-30, 1956

in NEW YORK'S great new COLISEUM

Your progress is keyed to your supply of ideas, and in today's competitive markets, it's vital to be *refreshed* from time to time with new facts, new "wrinkles," new trends. There is no better way of getting on the inside track of *what's new* in every phase of power production and use than by attending this fact-filled exposition!

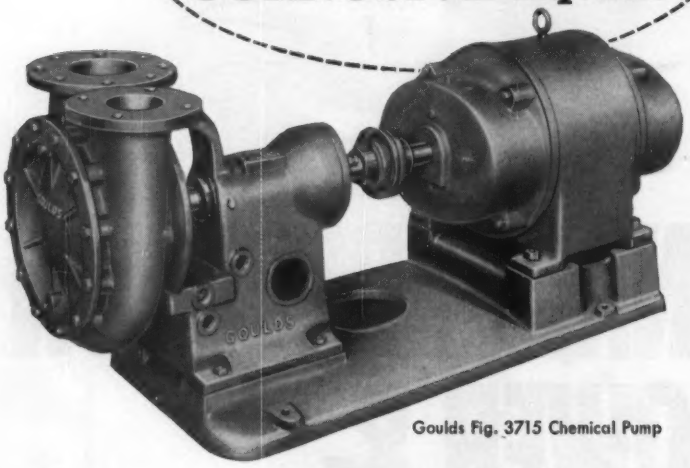
HUNDREDS OF ABSORBING EXHIBITS showing new equipment, new techniques, new applications in every field —including ATOMIC ENERGY—will be dramatic reminders of the tremendous advances with which *your* business must keep pace! NEW IDEAS—yours for the taking—will stimulate your thinking and profit you over and over again.

PLAN NOW to come, and to bring your key men.
SAVE TIME—write today for advance registration to

22ND NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING
480 Lexington Ave., New York 17, N. Y.

MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY

Here's a pump especially designed for your ABRASIVE and CORROSIVE liquids



Goulds Fig. 3715 Chemical Pump

You minimize your "hot" pumping problems — and expenses — with Goulds chemical pumps because *they're built to take it!*

With the Fig. 3715 pump, you can handle liquids that would "murder" most pumps. Such liquids as acid, alkaline liquor, hot size, and slurry. But this pump offers more than just severe service design. You get fewer maintenance problems plus special operating advantages.

For example

Look at the support head—its rugged, box-type design with water jacket permits you to pump liquids as hot as 350° F. Over-lubrication is prevented by grease-lubricated standard bearings with grease relief. You can adjust impeller clearance without any dismantling by means of a simple, positive external arrangement.

A variety of construction materials meets every need. Goulds Fig. 3715 pumps come in Type 316 and Gould-A-Loy 20 stainless steel, all aluminum-bronze, all iron or bronze-fitted.

More reasons why

There's a wide range of sizes, too—nine in all—with capacities up to 720 GPM and heads to 200 feet. You can keep a low spare parts inventory since many of the parts are standardized for interchangeability between sizes.

There are many more reasons why you can save money and avoid maintenance headaches by pumping those harsh liquids with a Goulds Fig. 3715 pump. Learn about them by addressing your inquiry to Goulds Pumps, Inc., Seneca Falls, New York.

ASK FOR BULLETIN 725.4.

Goulds PUMPS INC. Seneca Falls New York

MEMBER

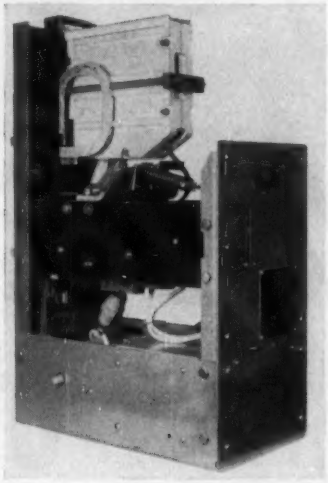
SALES OFFICES: Atlanta • Boston • Chicago • Houston • New York • Philadelphia • Pittsburgh • Tulsa

More EQUIPMENT NEWS

Begins on page 162

sealing edges, show no torque leakage at low-pressure differentials, no spiral twist failures and no rolling with pulsating pressure. Manufacturer states that if properly installed, they can operate as rotary seals and provide an efficient double seal for static installations. Request full details.

Minn. Rubber & Gasket Co, 3630 Wooddale Ave, Minneapolis, Minn.



Dc circuit breaker

1134 • *FB-12* current-limiting dc circuit-breaker is operable at 1000 volts and 1200 amps continuous. Primary applications will be for protection of generators, and traction or driving motors; also for feeder breakers and, in multiple pole assemblies, for anode protection.

FB-12 was designed for extremely fast tripping and interruption of fault currents. It will interrupt in a total of .012 seconds, and limit current magnitude in .004 seconds. Breaker can be set for high speed tripping on either forward or reverse current.

Unit is built in single and multiple pole assemblies, each with its own closing motor. It can be wired for individual pole reclosing or automatic reclosing.

I-T-E Circuit Breaker Co, 19th and Hamilton Sts, Phila. 30, Pa.

For more details on these items, use post cards p 171. Identify your request with item number.

Nylon conveyor fabric

1136 • Nylon-filled fabric provides muscle for conveyor belt according to manufacturer. Belt made with five plies of *Nyfil 120-RS* fabric is said to be as strong as steel cord belt rated at 1000 lb per in. per ply.

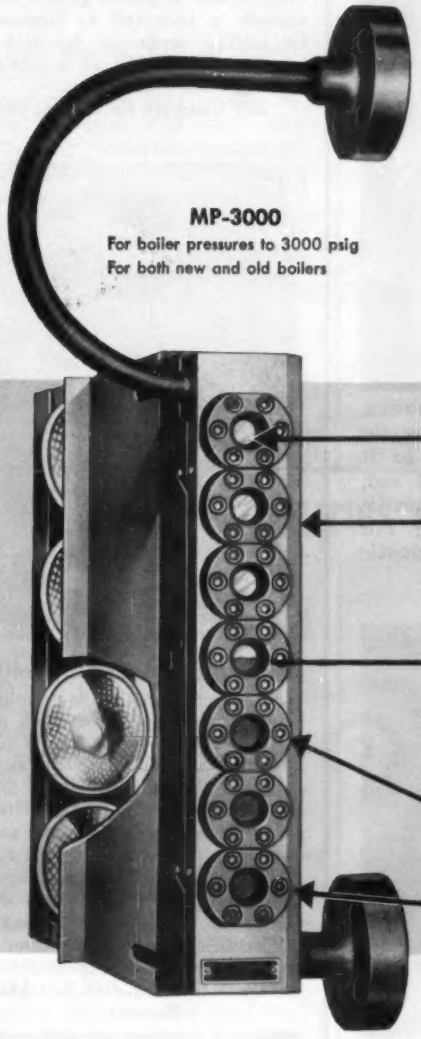
Super-strength rayon with nylon filler permits belt operating tensions up to 200 lb per in. per ply width according to manufacturer.

Advantages of longer single flights of belts are said to include elimination of transfer points, reduced installation and maintenance costs, and longer belt life.

Belts made with resilient nylon filler

MORE THAN 950 DIAMOND MULTI-PORT GAUGES

In use and on order for over 240 Central Station Generating Plants



MP-3000
For boiler pressures to 3000 psig
For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED
WATER SHOWS GREEN

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 950 for central station generating plants, more than 100 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

Write for Bulletin 1174U for more information.

7625

Diamond

POWER SPECIALTY CORP.

LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*

With R/M's Big 7 Packing Types you decrease costs, increase efficiency

With R/M's Big 7 you can cut costs and downtime. You'll also reduce any chance of error through wrong selection, simplify ordering, and speed deliveries. Most plant engineers find that they can fill all of their packing needs with only 3 or 4 types.

Engineered for top performance. Type 7, R/M Vee-Flex packing, for example, is precision molded to fit practically every piston and rod, and its unique design makes it self-sealing and self-adjusting. For perfect hydraulic and pneumatic sealing to 6000 psi and above.

Your R/M distributor has complete information on the R/M Big 7 line, and he will be glad to show you how standardizing on the Big 7 will pay off in your plant. All R/M packings for maintenance purposes are sold only through authorized R/M distributors.

Type 1, for pumps, valves; **Type 2,** for high temperature valve stems, expansion joints; **Type 3,** for high speed rotary air compressors; **Type 4,** for corrosives, acids, viscous materials; **Type 5,** "Teflon"* for chemicals; **Type 6,** gasket materials; **Type 7,** for hydraulic and pneumatic equipment.

*Du Pont trademark

R/M'S BIG 7 PACKING TYPES MEET 95% OF ALL PACKING NEEDS

R/M **BIG 7 PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Crawfordsville, Ind.; Neenah, Wis.; Peterborough, Ontario, Canada.

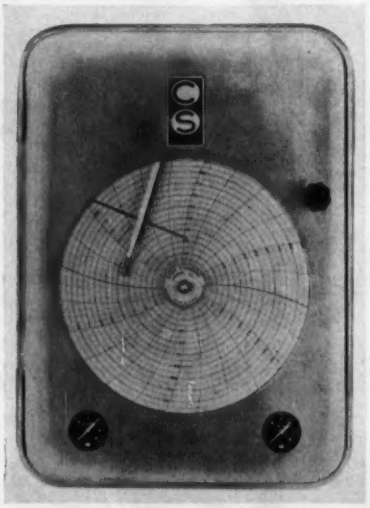
RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Laundry Pads and Covers • Bowling Balls

More EQUIPMENT NEWS

Begins on page 162

have exceptional flexibility for better troughing and outstanding resistance to impact, manufacturer says. High-strength nylon is said to provide greater crosswise strength in belts and an improved belt for holding mechanical fasteners. *Nyfil* belts are available for all industrial uses, both light and high tension.

B F Goodrich Co. Akron. Ohio



Pressure, temperature controls

1133 • *Type 57* pneumatic recording controller controls and records both pressure and temperature. Models have 9 or 12 in. spring or electric driven charts and on-off or 1-100% proportional action. Pressure ranges are from 0-5 to 0-5000 psi (0-25,000 psi for 12-in. single pen only) and temperature is from –350 F to 1200 F.

Type 58 recorder records temperatures in same ranges as *Type 57*. *Type 58* comes with 6, 9 or 12-in. charts, are spring wound or electric driven and have from one to four recording pens. Request details.

A W Cash Co, P.O. Box 551, Decatur, Ill.

For more details on these items, use post cards p 171. Identify your request with item number.

Non-porous rubber

1137 • *Compound RRD-992*, supersoft, non-porous rubber, can be vulcanized or bonded to metal. This rubber has a softness characteristic of 5 durometer and can be used in temperatures up to 200 F. Manufacturer claims that it is a reason-

TURBINE AND DIESEL LUBRICANT GUIDE

CITIES SERVICE TURBINE OILS

Manufactured from the highest quality, solvent refined stocks, these oils have high viscosity index, excellent heat resistance. They are chemically fortified to prevent oxidation, rust, and foaming, permit smoother operation.

PACEMAKER 300-T

For use in the lubrication of steam turbines with single reduction gear units. Also for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are not above 200°F.

PACEMAKER 500-T

Suitable for the lubrication of ring-oiled bearings of auxiliary turbines where operating conditions require an oil of heavier body than Pacemaker 300-T. Also recommended for use in separately lubricated turbine gear reduction units.

PACEMAKER 150-T

Recommended for pressure-circulation systems of direct-connected steam turbines, and for the bearings of turbo-generators where pressure-circulation of the oil is employed.

PACEMAKER 400-T

Recommended for the lubrication of propulsion turbine units on naval and commercial vessels, in pressure-circulation systems.

PACEMAKER 750-T

Recommended for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are in excess of 200°F., and use of a heavier bodied oil is required.

CITIES SERVICE DIESEL OILS

Made in the world's most modern lubricating oil refinery at Lake Charles, Louisiana, Cities Service Diesel Oils are blended from highest quality, high V.I. mineral oils and fortified with specially developed additives. There's a Cities Service Diesel Oil tailored for top performance in every type of diesel operation.

D-C 300 SERIES

These oils are designed to fully conform to Military Specification MIL-L-2104A. Made from the finest base oils, they are strongly fortified against oxidation and corrosion. They have the necessary detergent-dispersant properties to insure superior lubrication performance in high speed Diesel engines operating under heavy duty service.

Recommended for service DG under A.P.I. classification system.

D-C 100 SERIES

These oils are designed to conform to U. S. Army Specification 2-104B (Supplemental List 1). They are also known as Superior Lubricants Series 1 and are intended for more severe service than the D-C 300 Series Oils. Particularly recommended for the lubrication of medium and high-speed Diesel engines using lower quality fuels.

Recommended for service DM under A.P.I. classification system.

D-C 500 SERIES

These oils meet the requirements of The Caterpillar Tractor Company for a "Superior Lubricant (Series 3)". They have the highest level of detergent-dispersant action with maximum oxidation and corrosion protection to assure reliable operation of Diesel engines under most severe service conditions or where low quality fuels of very high sulphur content are used.

Recommended for service DS under A.P.I. classification system.

PACEMAKER SERIES

The new Pacemaker line of Diesel engine oils is made from the same high quality base oils as are the Pacemaker T Series, and contains similar additives, but in lesser amounts. These oils are adaptable for use in many low and medium speed stationary engines operating under conditions which would not require the use of heavier fortified oils, such as the Pacemaker T Oils.

PACEMAKER T SERIES

These are medium duty, high grade, high V.I. oils fortified against oxidation, rust and foam. Admirably suited for slow and medium speed engines employing the dry sump system of lubrication and operating under conditions where the service is not severe enough to benefit from a full heavy duty oil.

NEPTUNE 9000 SERIES

Designed specifically for lubrication of marine-type Diesel engines, both military and commercial.

Neptune 9000 Series Oils are made from high quality, high V.I. solvent refined stocks and are strongly fortified against oxidation and corrosion. They are specially inhibited against silver alloy bearing corrosion and have the necessary detergent-dispersant properties to give maximum performance under severe operating conditions.

These oils conform to the requirements of Military Specification MIL-L-900 C (SHIPS) for marine Diesel engine lubrication.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Specify

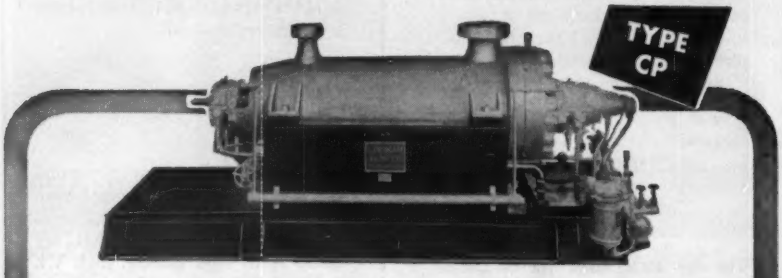
Bingham

"DOUBLE VOLUTE" BOILER FEED PUMPS

for the ultimate in dependability

IN HIGH PRESSURE SERVICE

Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY

General Offices: 2800 N. W. Front Ave., Portland 10, Oregon

Factories: Portland, Ore. • Vancouver, B. C., Canada

SALES AND SERVICE OFFICES

Boston, Mass.	New York City, N. Y.
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Denver, Colo.	Seattle, Wash.
Houston, Texas	St. Louis, Mo.
Kansas City, Mo.	St. Paul, Minn.
Los Angeles, Calif.	Tulsa, Okla.
New Orleans, La.	Toronto, Ont., Can.
Vancouver, B. C., Canada	

More EQUIPMENT NEWS

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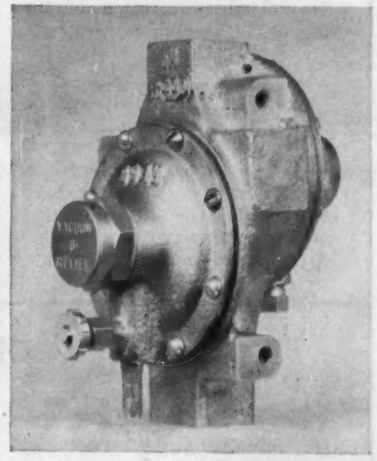
ably good electrical insulator and can be used to absorb vibration, dampen sound, or as an air-tight or water-tight gasket.

RRD-92 is made in sheets or strips up to 1 in. thick, or can be molded or bonded to metal or to other shapes to fit the customer's needs.

Manufacturer invites engineers to request free samples and more information.

Roth Rubber Co, 1860 S 54th Ave, Chicago 50, Ill.



Pressure vacuum bleeder

1138 • Pressure vacuum bleeder device for sealed-type power transformers combines both pressure and vacuum relief mechanisms in one housing, and includes provision for mounting a pressure vacuum gage. A larger diaphragm, centered with .008 in. tolerance, has increased the sensitivity to pressure changes.

All working parts are self-draining, free of condensate in cold weather, according to manufacturer. Sampler valve for removing a sample of gas from the transformer without de-energizing it also permits draining of vapor condensate. To prevent infestation by insects, vent outlet is protected with stainless steel screen and is shielded by a specially designed shroud.

Bleeder limits slow changes in tank pressure, due to temperature changes and variation in load, to values ranging from 5 to 10 psi positive and 5 to 8 psi negative pressure depending on customer specifications. Request complete details.

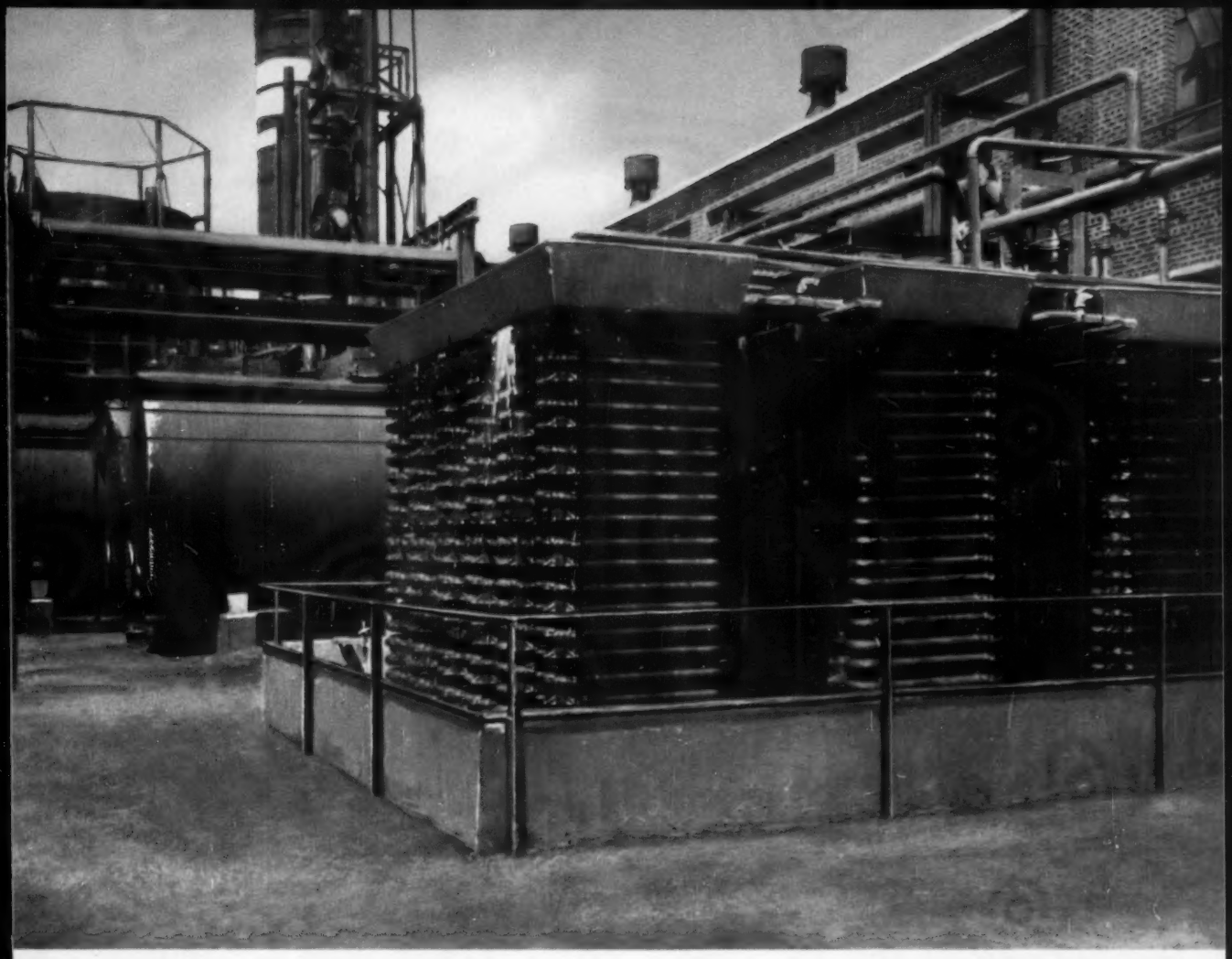
General Electric Co, Schenectady 5, N. Y.

For more details on these items, use post cards p 171. Identify your request with item number.

Base anion exchanger

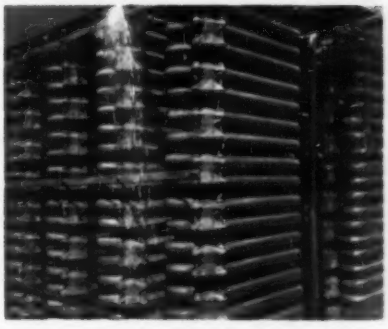
1127 • High capacity, porous type resin is expected to find use in field of demineralization of water as well as in processes such as sugar refining, uranium processing, plutonium recovery. Spherical particles are said to be strong yet flexible. Particle size has been selected to obtain best possible hydraulic characteristics.

National Aluminate Corp, 6216 W 66th Place, Chicago 38, Ill.



NALCO blue

that signals CORROSION PREVENTION



Nalco blue on these exposed cooling unit coils is the visible evidence of effective corrosion prevention at work. Nalco System chemicals used in this installation form a tough protective film of characteristic blue color on all ferrous metal surfaces. The metal is literally sealed off from direct contact with water, air and fumes, yet the film itself will not impair heat transfer efficiency.

Similar Nalco protection for your plant can cut maintenance costs and protect you against unscheduled shutdowns that are frequently caused by damaging corrosion. Call your Nalco Representative for some facts and figures on Nalco System protection and economy.

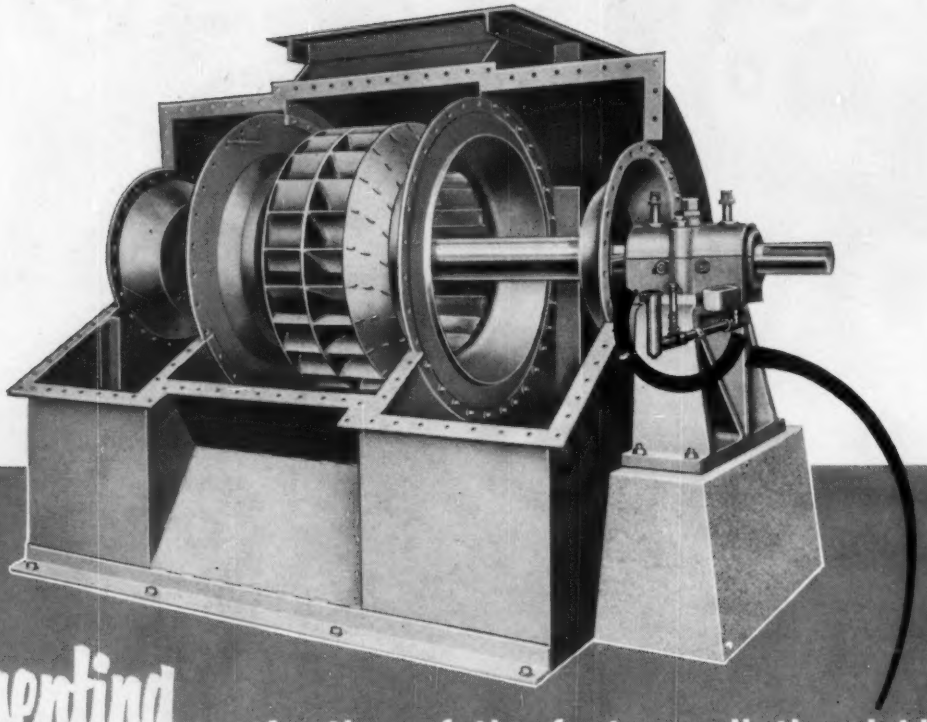
NATIONAL ALUMINATE CORPORATION

6208 West 66th Place — Chicago 38, Illinois

Telephone: POrtsmouth 7-7240

CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII AND ALASKA:
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH
SPAIN: Nalco Espanola, S.A.

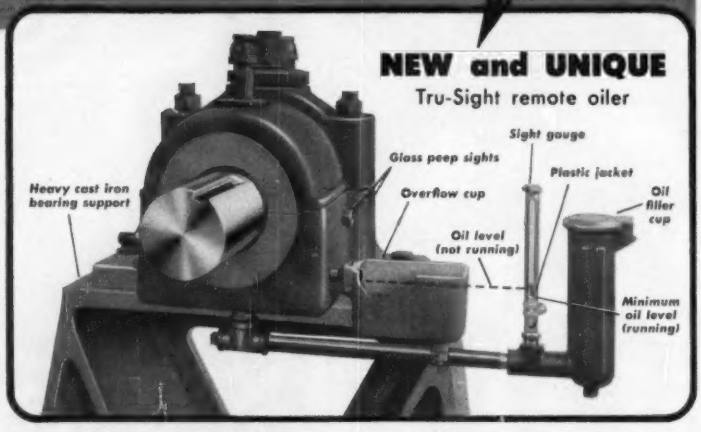
THE *Nalco*® SYSTEM . . . *Serving Industry through Practical Applied Science*



Presenting... Another of the features distinguishing CLARAGE MECHANICAL DRAFT FANS

You get more than extra-heavy construction, extra-long service life from a Clarage Fan. You now get a vastly superior oiling arrangement for the bearings — as shown on the right.

Send for Catalog 901-A describing the Clarage Type RT Fan and the many features that have made it the stand-out performer in forced and induced draft service. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

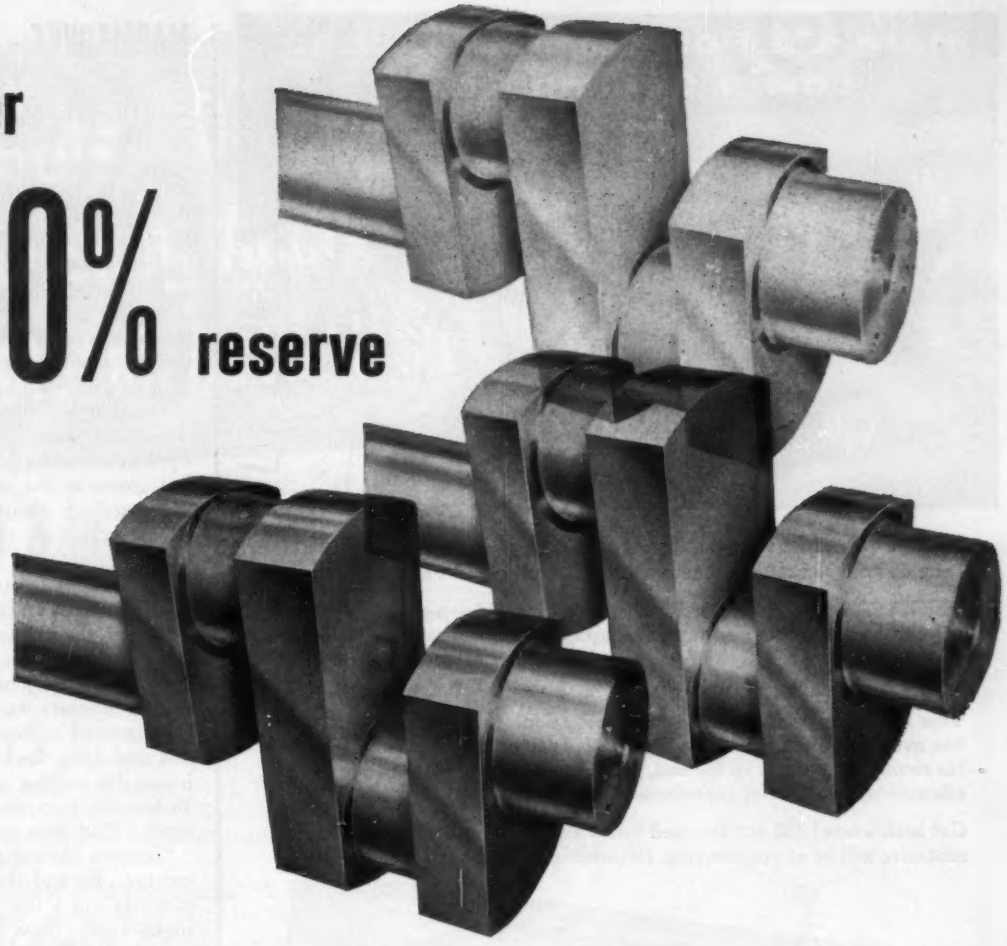


Designed to simplify maintenance, this Clarage Oiler provides for accurate remote oil level indication when fan is running or not running . . . simplified oil level adjustment . . . quick filling . . . automatic overflow to prevent overfilling . . . cleanliness due to improved shaft seal effectiveness and use of overflow cup.

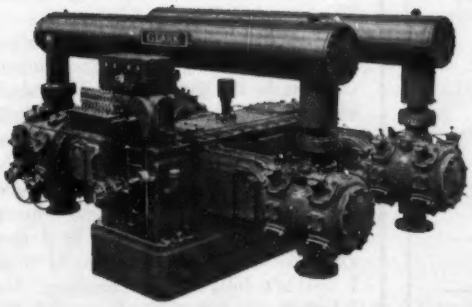
CLARAGE ... dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

Over 300% reserve



Built in the Crankshafts of many Clark Balanced/Opposed Compressor Models



CLARK 350 BHP BALANCED/ OPPOSED AIR COMPRESSOR

Extra-heavy crankshafts are standard equipment on Clark Balanced/Opposed compressors . . . it's brought about by standardization.

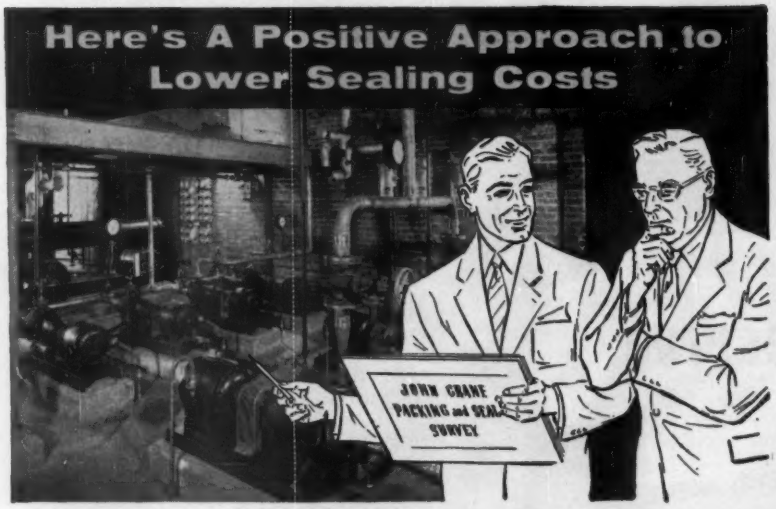
All models of a particular stroke size have the same bearing and crankshaft diameter. As an example, the number one crankpin of all CMA models is capable of transmitting with complete safety 600 BHP. The CMA-2 rated at 150-300 BHP and the CMA-4 rated at 350-500 BHP therefore have a tremendous reserve. The same thing applies to the 14" and 17" stroke CRA and CBA models.

Rugged shaft construction assures maximum bearing life and minimum maintenance. It also eliminates the need for a bearing between opposing cylinder crankthrows which would double the force couple between opposing cylinders and in turn increase shaft stress and foundation requirements.

Your nearest Clark representative will be pleased to give you all the facts on the original Balanced/Opposed compressors, or write for bulletin 118.

CLARK BROS. CO., OLEAN, NEW YORK
One of the Dresser Industries
Offices in Principal Cities Throughout the World

CLARK **Balanced/Opposed Compressors**

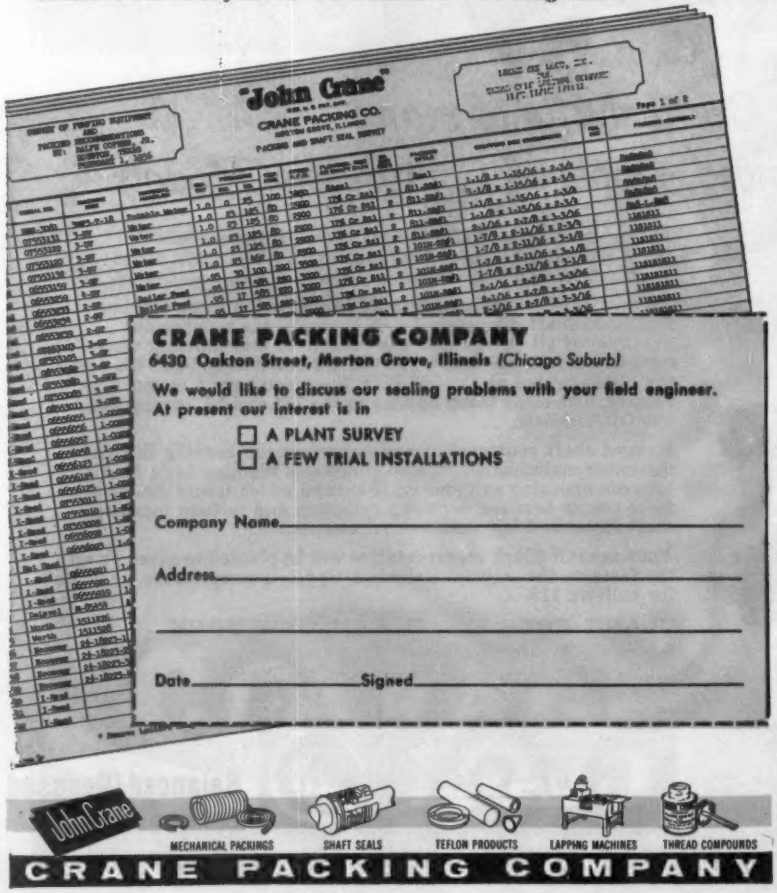


Put yourself in this picture . . . You're getting "down-to-earth" facts on how you can save money through more efficient sealing methods.

How? A "John Crane" trained field engineer is making a complete survey of your pumps, valves and any other equipment where sealing is required —and is carefully analyzing your needs. He's an expert. You could see that as soon as he went to work.

This service is being given without obligation. The "John Crane" man has even suggested a few trial installations to prove the effectiveness of his recommendations. In the end, you'll be well ahead with sealing methods substantially better than those you are now using.

Get action now! Fill out the card below and a "John Crane" field representative will be at your service. Remember—no obligation!



MARMADUKE

Continued from page 150

school's power plant or discharge into the reservoir up on the hill.

"Both pumps were running when I took over my first watch. But they didn't sound right and were running too fast. I reported this next morning to Seth Burgess, who was in charge of the works. Burgess looked after the school buildings and was a fast-talking promoter-type of guy. He made some remark about more water being used than in the past and let it go at that.

"After a few weeks the pumps got worse and started getting very noisy. By then the water level in the reservoir had gotten so low that Burgess had to do something about those pumps. I offered to find the trouble. But the old boy surprised me by getting on his high horse and letting me know he wasn't looking for advice.

"When the flashy old goat finally came back a few days later to look at those galloping pumps, they had developed a severe water hammer. I had experimented a little on my first night and shut down the big pump for a few hours. On starting up, she ran fine for 30 minutes, then started running away again. That gave me my answer.

"Burgess showed up again the next evening. He had the machine-shop instructors and a few others in tow. Between them, there should have been enough know-how to tame those duplex pumps. After some masterminding, they decided on a complete overhaul—work to be done in the school machine shop.

"New liners were put into the liquid end, plungers repacked and new piston rings made for the steam end. Then the steam- and water-end valves were ground in. Any way you look at it, the students made a swell overhaul. No doubt about it, those pumps had innards that were as good as new. But there was still one little thing wrong. The pumps galloped as before.

"The big boys went into another huddle. They made a few minor changes in the pump, reset the valves and put in lighter valve springs. Still no dice. Then one day the pump manufacturer's salesman showed up. Since he was an expert, the top brass gathered around him. The salesman's theory hinged on proper venting. So larger air cocks were put into the liquid ends. I couldn't follow their reasoning, but I kept my mouth shut. Even with the changes, those pumps still sounded like rock crushers.

"Next day when the brain trust came around again, I started to make a suggestion. But the chief gave me the cold shoulder and cut me short.

"That night, to put Burgess on the

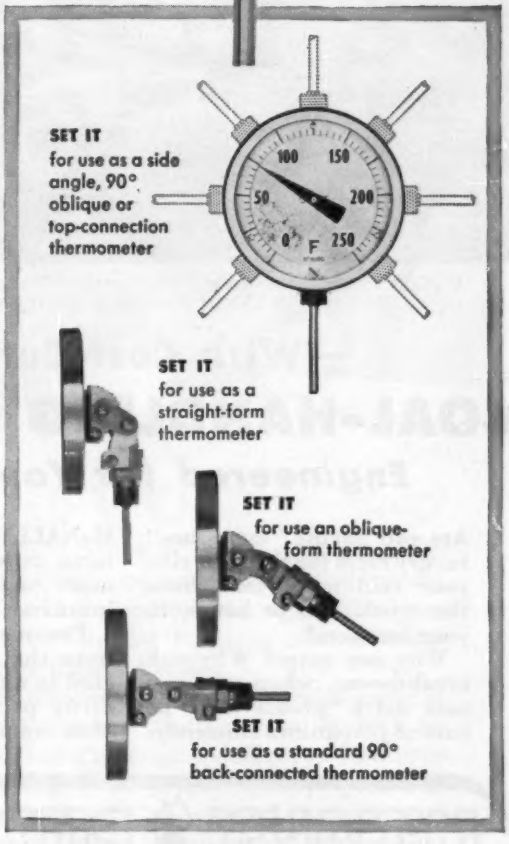
"Every Angle" Design Maxivision® Accuracy Bi-Metal Actuation

Now... all 3 in one 'American' Thermometer

Only this new American Thermometer* gives you the three features most demanded in a dial thermometer. The "Every Angle" design allows you to install this thermometer *anywhere* . . . then angle it in the direction that provides easiest reading. The anti-parallax Maxivision dial guarantees the surest, sharpest, easiest reading. Graduations are carried on a raised ring, set close to the cover glass, with an index-type, functional pointer set at the same level. The result — no perspective effect — parallax error practically eliminated. Finally, bi-metal actuation insures high sensitivity, economy, and surety of operation.

Install the new American "Every Angle" Bi-Metal Dial Thermometer anywhere — inside or out. Its climate-proof case defies any weather condition. The full use of these thermometers in any process plant makes possible temperature readings with the same ease and facility of those of a pressure gauge. Write today for complete information. Ask for Bulletin 148.

*Pat. App. For


SET IT
for use as a side angle, 90° oblique or top-connection thermometer
SET IT
for use as a straight-form thermometer
SET IT
for use an oblique-form thermometer
SET IT
for use as a standard 90° back-connected thermometer

SPECIFICATIONS

5-Inch Type 5-6060 American "Every Angle" Bi-Metal Dial Thermometer

Temperature Ranges: From minus 80° to plus 1000° F. Accuracy within 1% of range. *Dial Size:* 5". Scale approximately 10½" long. *Bi-Metal Coil:* Low mass, with single helix close to inside wall of stem assures high sensitivity. Silicone fluid dampens vibration, accelerates transfer, speeds response. *Case:* Stainless steel. *Bezel:* Threaded to case. *Front:* Clear, extra-heavy glass set in channeled gasket to seal case. *Pointer:* Functional type, adjustable from front. *Stem:* Lengths — 4" to 24", 18-8 stainless steel. All joints welded. *Connection:* Fixed, ½" NPT. *Separable Sockets:* Available in all materials and sizes normally required.

PHONE your Industrial Supply Distributor for experienced attention to your needs. He is always ready to help you ward off costly shut-downs through fast delivery from local stocks.

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

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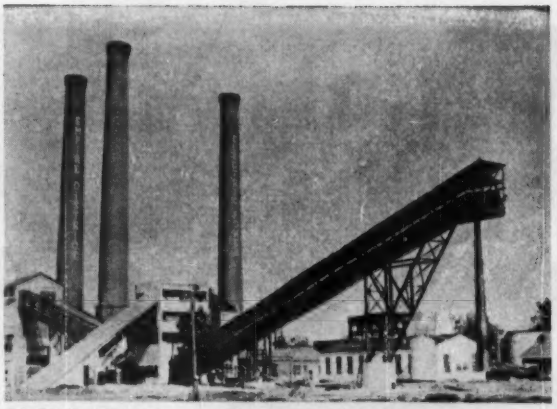

McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

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McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____

MARMADUKE

Continued from page 192

right track, I got hold of a vacuum gage and connected it to the suction line. Just as I thought, there was about 20 in. of vacuum, and that with a 6-psi head of water against the pump. Next watch, when Burgess came around and saw that gage, he observed with a shrug, 'A good pump is supposed to build up a vacuum—how else can it pump?' I didn't try to answer that one. To me, that high vacuum proved only one thing. The suction side of the system was tight, and no mistake about it.

"I finally got tired of watching those two pumps knock themselves out while those clowns kept navigating in circles. So next morning I walked into Burgess' office. As luck would have it, he had an audience of a half dozen people. There was the school's director, the mayor and some of the school's instructors. The mayor was worried about keeping the new homes in the area supplied with water. The director was worried about the water for his buildings. Between them, they had Burgess backed to the wall.

"While they were yak-yaking, I barged in and said as diplomatically as I could, 'There's nothing wrong with those pumps. Only trouble is with the jackasses monkeying with them.' Tha' did it. Burgess tried to say something but he could only sputter.

"'Just what do you mean?' asked the director, giving me a cold start.

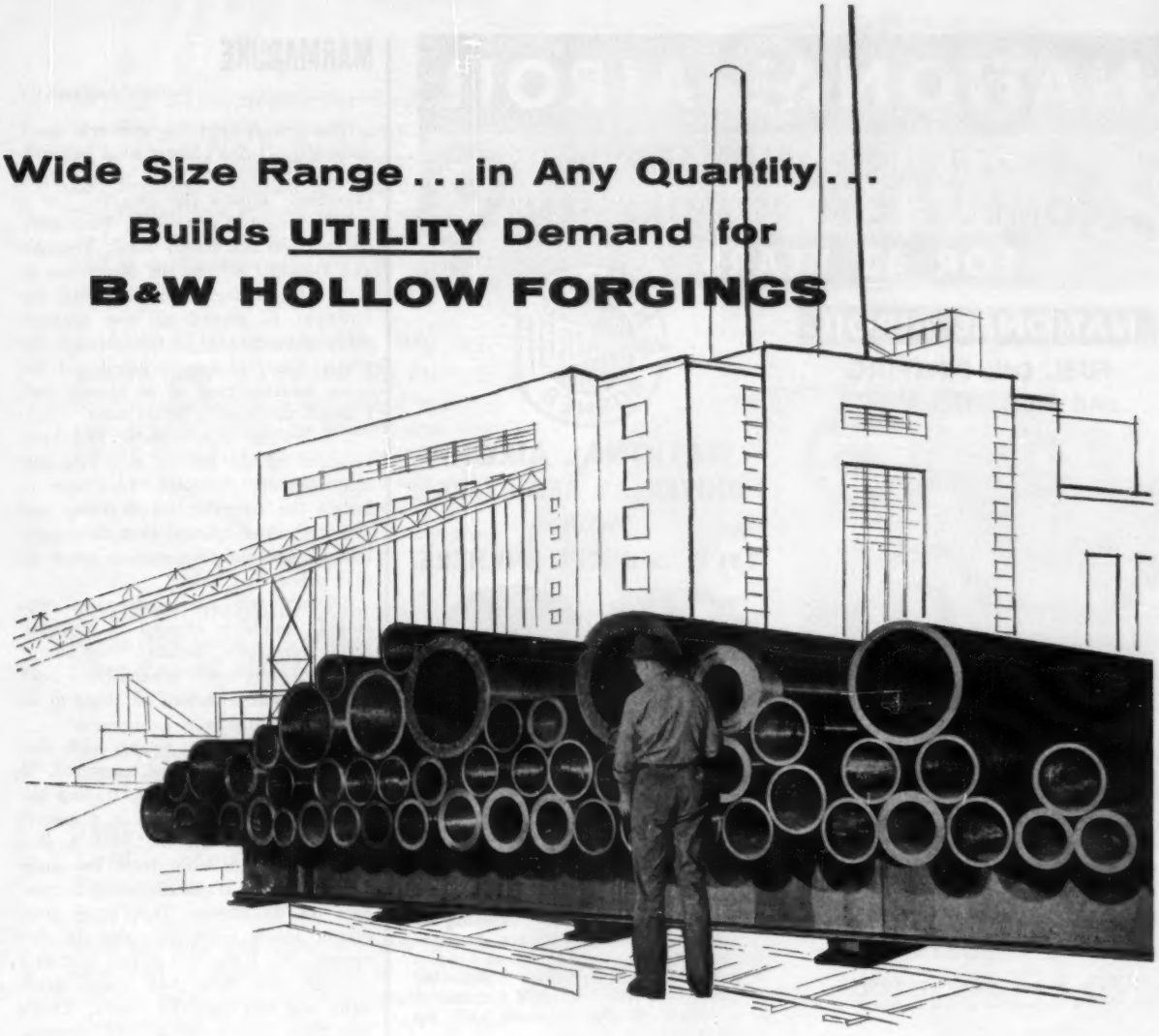
"'Just what I said,' I answered. 'I've been trying to tell Burgess here that I can straighten out those two pumps but he won't even listen to me. I can have them running like they're supposed to by tomorrow morning. And I won't take anything apart. Fact is, I won't make any changes in the plant at all. And, what's more,' I added, 'I'll do that in a few minutes tonight after supper, if someone'll relieve me in the pumping station.'

"'Exactly what do you know about those pumps that our staff doesn't know?' asked the director. He was getting interested.

"'I know enough to straighten them out,' I answered. 'But now it'll cost you a first-class pullman fare to Buffalo.' They saw I meant business. They kicked the proposition around for a few minutes, then gave me the green light.

"That evening I took a walk downtown. When I got back to the plant at 9 pm, a half-dozen big shots were standing around, watching the pumps. I didn't hear any noise. Those machines worked smoothly, with even, powerful strokes. (*Continued on page* 196)

Wide Size Range . . . in Any Quantity . . . Builds UTILITY Demand for B&W HOLLOW FORGINGS



American Gas and Electric...Carolina Power & Light . . . Commonwealth Edison . . . and Wisconsin Electric Power, are typical of the leading Electric Utilities that use B&W Hollow Forgings for main steam, reheater, feedwater, and similar lines.

They find B&W Hollow Forgings offer a sound solution to their piping problems. Available in a wide range of sizes and material, these heavy-duty forgings can be specified to exact design requirements delivered right to the job, *in any quantity.*

Because they are made from high quality carbon, alloy and stainless steels, carefully produced under controlled conditions from the initial melt through final inspection, B&W Hollow Forgings offer the user savings in time and money.

Also, because of B&W's specialized manufacturing process, Hollow Forgings can be made to unusual design specification—either in special shapes or with special end preparations such as end closures, reduced sections, and Van Stone flanges. For additional information, write directly to The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

Ask for this Bulletin: S-16B

BABCOCK & WILCOX

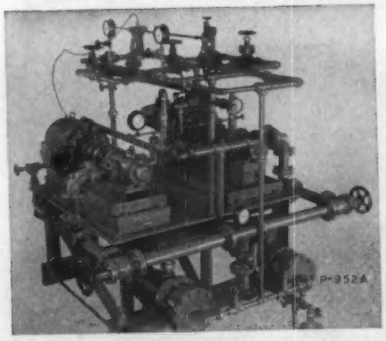
BOILER DIVISION

S-461

NATIONAL AIROIL

SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 43 YEARS

NATIONAL AIROIL FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

NATIONAL AIROIL COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

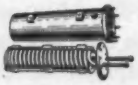
FUEL-OIL SUCTION STRAINER

WIDE VIEW PEEPHOLE

IGNITION PORT

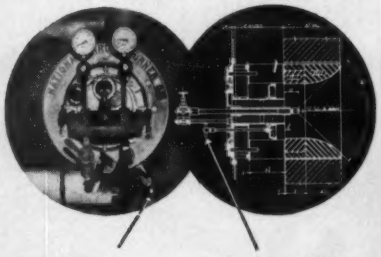
FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER



These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
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GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
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Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

MARMADUKE

Continued from page 194

"Burgess popped up and said good naturedly. 'I don't know what you did, but I've never seen these pumps work smoother. What's the secret?'

" 'No secret,' I answered. 'First week on this job my friend Hank Younger and I looked up the old blueprints at City Hall. I found someone had the foresight to record all the changes made in your water system through the years. Every change is dated and the exact location marked so clearly that I found the trouble in no time.'

" 'I learned that a valve had been installed on the suction side just outside the city reservoir. Idea was to isolate the reservoir for draining and cleaning. And I found that the supply line to this pumping station takes off just below that valve.'

" 'Don't tell me that valve was closed,' suddenly chimed in Burgess, acting suspicious, 'because these pumps started getting worse gradually. I don't see how that valve had anything to do with our problem.'

" 'There's nothing wrong with that valve in your hookup,' I answered. 'I found it wide open. But, tracing the drawings again, I found a pressure-regulating valve in the suction line about a quarter mile from the main shut-off valve. It's installed in a manhole pit downtown. There's no good reason for a valve like that in this system. So, I checked it and just as I thought, that valve had frozen gradually and was partially closed. That's why these pumps had a 20-in. vacuum, banged like rock crushers and wouldn't keep your reservoir up to level.' Everyone seemed impressed. Burgess just scratched his head.

" 'I worked that reducing valve open just a few minutes ago,' I continued. 'Better than that, I fixed it so it won't close again. You don't have to worry about those pumps starving for water in the future.'

"The director looked at Burgess as if asking for an explanation. Then like a real sport, he said 'You win. Whatever your name is, I'll buy that pullman fare whenever you need it.' Then, turning to Burgess, he said quietly, 'You can't lost anything by listening to people—especially when you don't know the answer yourself.' "

—*SME*

MARMY'S POPULAR HERE

Now that I've got all these fine little Marmy tales in *The Marmy Story*, I'll read them with increased interest. He is very popular with the engineers here at this large General Electric plant.

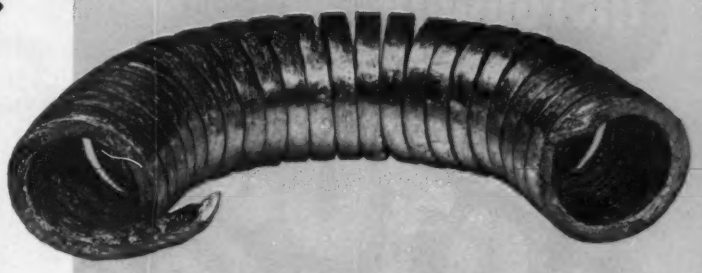
H J MALLIA *Schenectady, N. Y.*

SOLID ALUMINUM for End Rings on Very High Temperatures.

Style 861 Ring and Spiral is composed of a soft annealed aluminum foil folded, crimped and formed into uniform packing section. As end rings it is used on very high temperatures and in combination with other style metallic packings.

SOLID ALUMINUM with Dry Asbestos Core . . . on Hot Oil Pumps.

This is Style 862 Ring and Spiral packing, employing a high grade asbestos core over which is formed the twisted, crimped aluminum foil. The asbestos core produces a soft, yieldable packing for use on high speed, hot oil pumps operating in modern oil refinery processes among high temperatures.



SOLID ALUMINUM with Lubricated Asbestos Core . . . Where Temperatures Exceed 650°F.

Style 863 (not illustrated) Ring and Spiral employs a high grade asbestos core, lubricated and graphited to be easily yieldable. Highly effective for temperatures over 650°F.

TWISTED STRANDS over Asbestos Cord . . . on Oil Pumps and Valve Stems Where Temperatures Exceed 500°F.

Style 864 Ring and Spiral is highly flexible, composed of multiple strands of lubricated asbestos yarns, each strand surrounded by an aluminum foil jacket. Style 864 is used on high speed hot oil pumps, high temperature valve stems, and on hardened valve stems and high speed boiler feed pumps.

HIGH TEMPERATURES DO NOT AFFECT THESE ANCHOR ALUMINUM PACKINGS!

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ELLIOTT COMPANY - ROTO DIVISION
Tube Cleaner Specialists Since 1910
153 Sussex Avenue, Newark, N. J.

BASICS

Continued from page 148

large temperature change. These alloys are used where a stable resistance is particularly important, as in measuring instruments. In some conductors, carbon for example, the resistance decreases as the temperature increases.

Wire tables give resistance at standard temperatures such as 20 C or 100 C. To find resistance at ambient temperature use formula:

$$R_2 = R_1 [1 + a (t_2 - t_1)]$$

Standard temperature is t_1, ambient temperature is t_2; R_1 is resistance at t_1; R_2 is resistance at t_2 and a is temperature coefficient at standard temperature. It's plus when resistance increases with temperature, minus when resistance decreases.

Next month's Basic takes up: Series and parallel circuits.

CETANE NUMBER

Continued from page 119

oils or heavy residual boiler fuels. It may give too high a value for extremely volatile fuels or those containing much asphalt. Obviously, it does not apply if cetane number improvers are added.

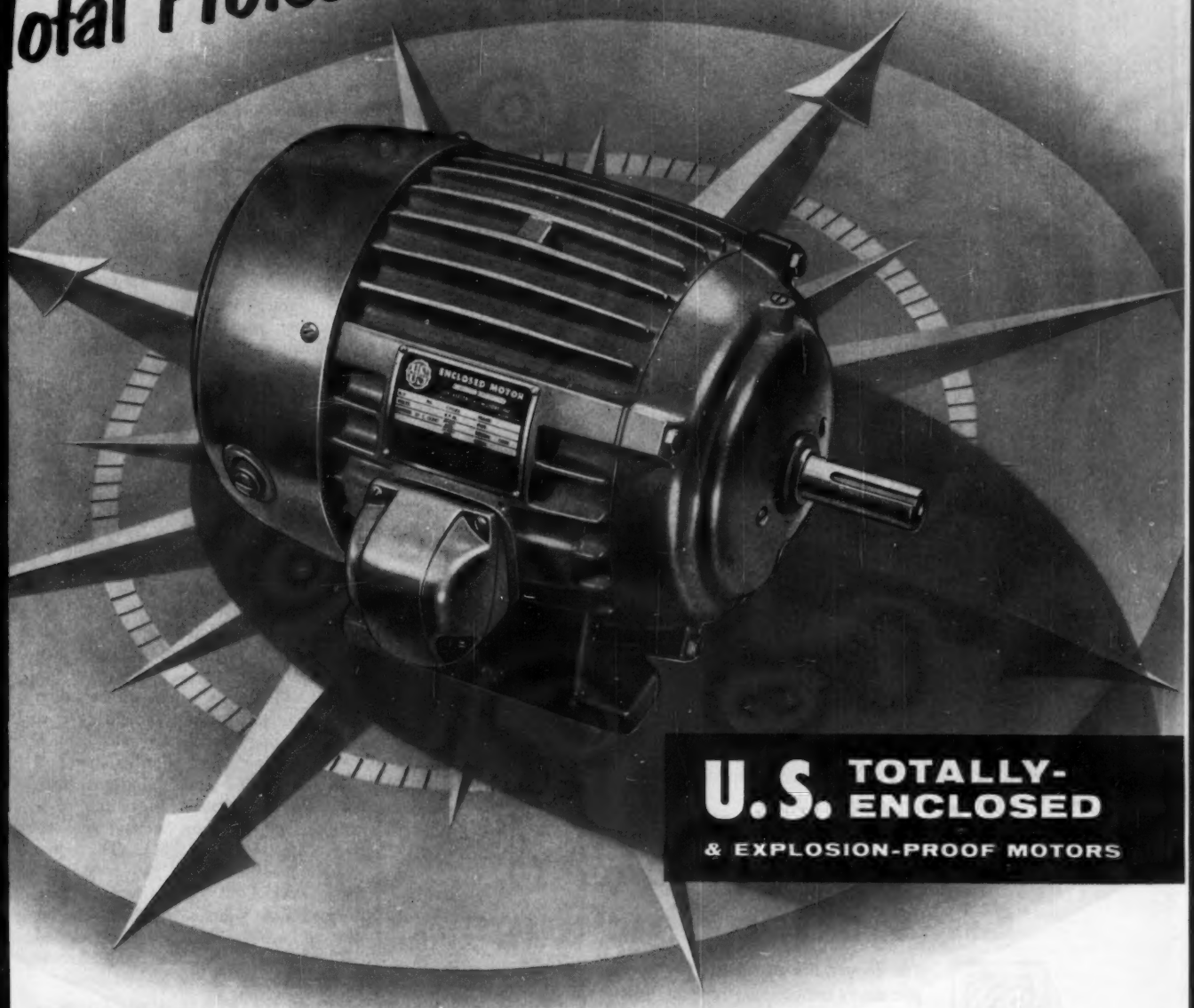
Standard-test fuels, adapted for measuring ignition quality of diesel fuels, are two hydrocarbon liquids—cetane and alpha methyl naphthalene. Cetane has very good ignition qualities, while those of alpha methyl naphthalene are very poor and cause engine troubles.

This brings us to a yardstick for measuring ignition qualities—which is the cetane-number scale. On this scale, cetane is selected as 100 and as alpha methyl naphthalene in standard fuel that matches ignition quality of tested fuel. Thus, if a fuel has same ignition quality as a mixture of 60% cetane in alpha methyl naphthalene, fuel's cetane number is 60. At any rate, it's important to know your cetane number.

Summary. Most stationary engines are not fussy about cetane number. They will run on otherwise suitable fuels in the 30 to 60 cetane-number range. In some cases they do a good job with even lower cetane. Remember that lower the speed, lower the cetane requirement. Lowest cetane fuel your engine burns without trouble is usually the most economical.

Cold starting and idling may call for a higher cetane. Very high speeds and dual-fuel operation also require higher cetane numbers, usually not less than 40 and preferably 45 minimum.

Total Protection...in Every Direction



U.S. TOTALLY-ENCLOSED & EXPLOSION-PROOF MOTORS

Protected AGAINST EROSIVE POLLUTION...
. U. S. Totally-Enclosed and Explosion-Proof otors provide all-around protection against cor- sion, weather exposure, bad contaminants, caustic nditions, dust and erosive elements. All types are EMA-dimensioned.

Protected AGAINST INTERNAL HEAT...
sbestos protected windings, cooling ribs, and a avy duty fan form outstanding features to give . S. Totally-Enclosed motors maximum protection ainst heat.

Protected AGAINST BEARING FAILURE...
Lubriflush transverse re-Lubrication is possible without disassembly of motor or fan guard. Grease fittings are outside. Lubriflush forces out old grease and injects new lubricant around and through the bearings.

Protected AGAINST SHOCK AND VIBRATION
...The hefty cast-iron frame of the U. S. Totally-Enclosed motor is normalized to provide a non-stress, single-piece structure. Rugged feet are integrally cast with the frame; not welded on.

U.S. MOTORS — U.S. Electrical MOTORS

U. S. ELECTRICAL MOTORS Inc. PO-11
P. O. Box 2058, Los Angeles 54, Calif., or Milford, Conn.
☐ *Send U. S. Totally-Enclosed Motor Bulletin #1879*

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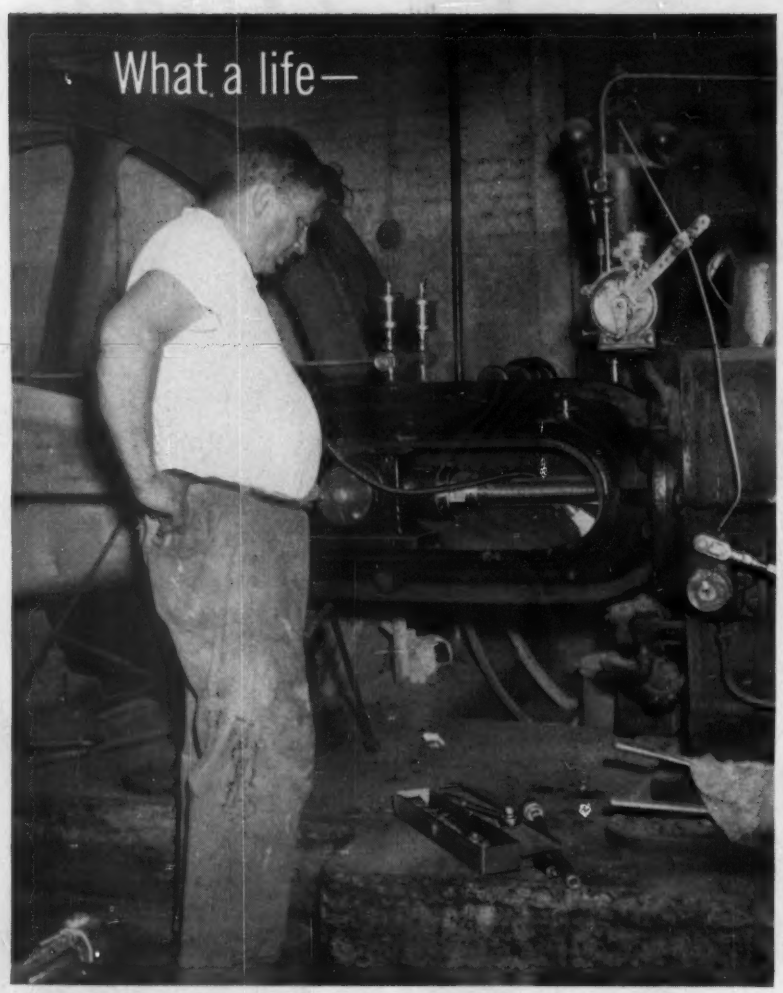
CITY_____ ZONE____ STATE_____



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In every city, there is a popular, well known company who stocks Chesterton Packings for steam, chemicals, oils, gases, etc. Drop us a line so that we can inform you who services the Chesterton users in *your* area. It costs less to buy *at home*. You get better Packings when you specify Chesterton!

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MOTOR LUBRICATION

Continued from page 99

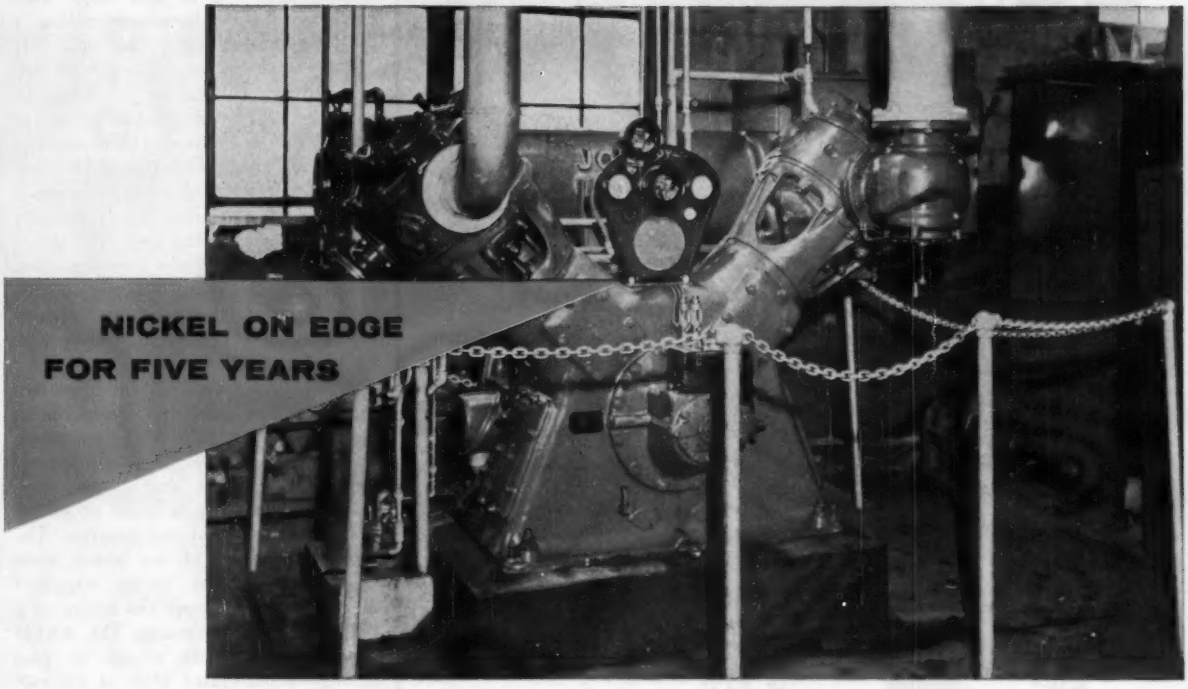
Synthetic greases. A variety of greases containing synthetic oils have been developed in recent years. These provide excellent service in electric motors below and above the temperature range in which petroleum greases are generally most useful (–25 to + 225 F). For lower temperatures, down to –100 F, and for higher temperatures, up to about 450 F, synthetic greases of the diester and silicone type can be used. Water resistance, surface active properties, high-load capacity, resistance to various atmospheres and fluids and other unusual requirements might dictate use of synthetic greases. In general, of types listed in table 1, only the silicone and diester types thickened with lithium soaps have found much use in electric motors. Some newly developed silicone greases thickened with modified aryl ureas appear promising for applications in 340 to 450 F range, and silicone-diester products should be considered from about –60 to –110 F.

Important properties of greases should be understood before selection. Grades vary in consistency from soap-thickened oil that is fluid at room temperature to brick-type greases that are so hard they must be cut with a knife. Most common test for measuring consistency uses a penetrometer which drops a cone of standard shape and weight into the grease and measures depth of penetration in tenths of a millimeter (American Society for Testing Materials D-217-52T). The penetration measured after the grease has been worked 60 strokes with a perforated disk plunger is the basis for the following classification developed by the National Lubricating Grease Institute:

NLGI No.	ASTM worked penetration
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

By far the greater proportion of electric-motor greases are in NLGI Grade 2. The consistencies of such greases are usually sufficiently stiff so very little trouble is encountered with churning, slumping or leakage. Yet the grease is soft enough so it feeds readily into the working parts of a bearing. Stiffer greases of NLGI Grade 3, and occasionally Grade 4, are used where good channeling characteristics are desired in large high-speed motors or in

Proof... the JOY WN-112 COMPRESSOR is Vibration-free



VICE PRESIDENT GEORGE F. FRANCK, of American Tank & Fabricating Company, Cleveland, writes about his Joy Compressor:

"Although the WN-112 has been in constant use for five years, we have experienced no trouble. It is vibrationless in operation . . . we are delighted with its performance."

The Joy WN-112 is a heavy-duty, continuous service, double-acting, water-cooled compressor with capacity from 378 to 974 CFM, 125 psi. Its vibrationless performance is the result of balanced V-vertical cylinder design with flange-mounted motor.

Other features of the WN-112 that assure efficient, quiet operation and long service are the exclusive Joy "Dual Cushion" valves, the *replaceable* cylinder and crosshead liners, full force-feed lubrication (even to the crosshead face), and oversize non-adjustable spherical-type main bearings.

For complete details on Joy WN-112 Compressors, write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

A nickel was balanced on edge on this compressor (American Tank & Fabricating Company) when it was started up five years ago. It is still standing there!

Write for FREE Bulletin 90-16

Consult a Joy Engineer

For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

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2

MOTOR LUBRICATION

Continued from page 200

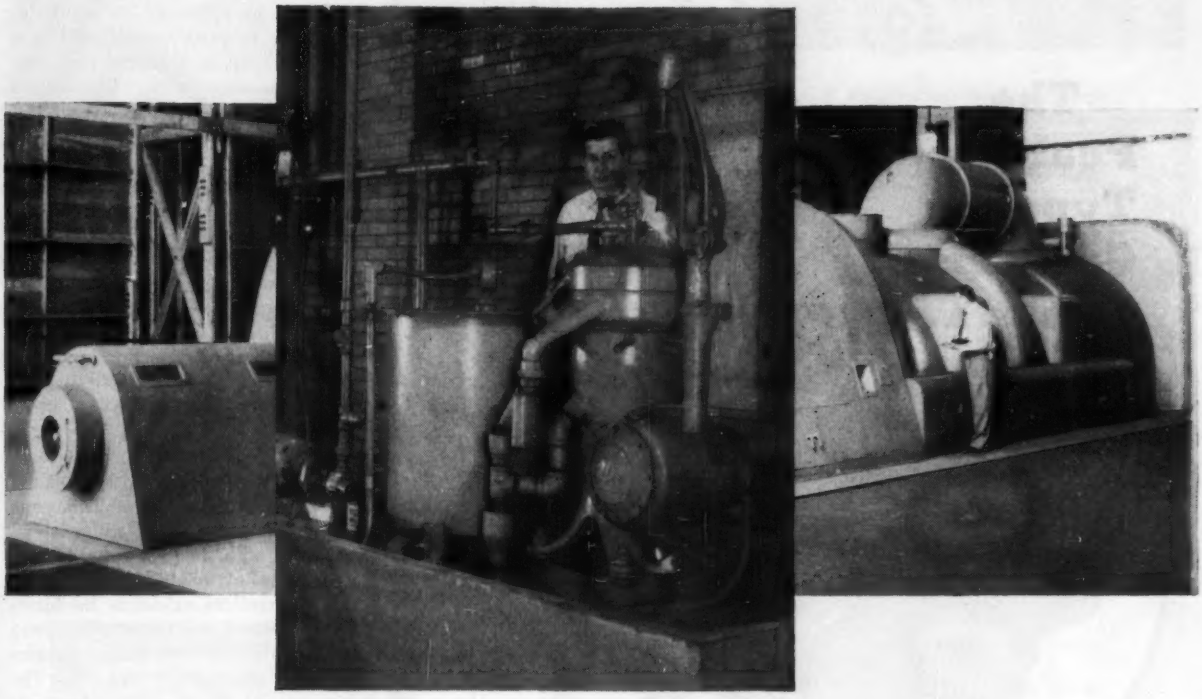
double-sealed or double-shielded permanently lubricated bearings where the grease must be totally confined and yet stay out of churning action of the ball complement.

Oil viscosity. Petroleum oils used in most greases are in SAE 20 to 30 range with 100 F viscosities of about 200 to 500 Saybolt seconds. Greases with oils in the upper end of this range seem particularly desirable in providing a low evaporation rate and long life while allowing free operation of medium-torque motors at temperatures down to –25 F. Somewhat lower viscosity oils can be used with a sacrifice in life for applications down to about –50 F. In temperature range of about 200 to 250 F somewhat higher viscosity oils are sometimes used in motor greases. For extreme temperatures, however, it is generally better to consider one of the synthetic greases rather than a petroleum grease with an abnormal oil viscosity.

Mechanical stability. It is important for the grease selected to maintain its desired properties during operation. Its consistency should remain relatively unchanged, and it should not cause trouble by churning, aeration or slumping under action of the bearing. Unfortunately, most of the bench scale tests developed by grease suppliers don't exactly duplicate the action of a ball bearing in a motor. The ASTM working test forces grease to pass through a perforated plate at the rate of 60 times a minute. A Shell roll test subjects grease to working action of a roller in a rotating cylinder. In these and similar tests, consistency of the grease is determined before and after grease is subjected to shearing action. For lack of adequate bench tests, trial operation of the grease in a motor is usually desirable. This trial should be carried out with an overpacked bearing housing, at high temperatures, or under any other severe operating conditions that might be encountered. Abnormally high power loss, high temperature rise, churning of the grease with aeration and leakage or possible noisy operation would be indicative of unsatisfactory mechanical properties.

Bleeding and evaporation. In addition to stability under mechanical agitation, a grease must maintain its lubricating properties for long periods while being subjected to various factors promoting loss of oil by both bleeding and evaporation from the soap structure. Generally when a grease has lost about half its initial oil content it is no longer satisfactory. For

DE LAVAL TURBINE LUBE PURIFIER SAVES $800 A DAY!



Recently, a turbine in the City of Detroit's power plant developed a water leak . . . so serious that under normal circumstances it would have meant a costly turbine shut-down.

But . . . because of a De Laval Turbine Oil Purifier installed in 1949 to operate with an oil reservoir serving all the turbines, or any individual unit . . . no shut-down was necessary!

The De Laval Purifier—switched to service the leaking turbine—continuously removed water from lube oil . . . let the turbine operate without shut-down . . . *saved $800.00 a day* it would have cost to cut in an old stand-by turbine!

At $800.00 saved per day, the De Laval Purifier paid for itself in less than six days. Even more important, it gave positive proof of the efficiency and economy of De Laval Purifiers in any situation—emergency or otherwise!

Get all the facts . . . that mean protection for your plant and equipment!

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Ignitor...

... for fuel burners provides quick, positive and stable ignition for all firing conditions. The simple turning of one handle accomplishes the full operating sequence to establish the ignitor flame.

This ignitor does not employ long electrodes or insulators. All electrical components and adjustable elements are located *outside* the burner windbox; only the flame tube passes through it. All working parts are always readily accessible even when the ignitor is used with a pressurized furnace. This rugged packaged unit, of attractive modern design, is built of the finest materials to give long life with minimum maintenance.

It fills the needs for a dependable, positive and safe ignitor for all types of fuel burners, and is available for manual operation, as illustrated, or with motor drive for remote control. For detailed information, write direct or call your nearest Peabody representative.

PEABODY ENGINEERING CORPORATION

232 MADISON AVENUE, NEW YORK 16, N. Y.
OFFICES IN PRINCIPAL CITIES
PEABODY LIMITED • LONDON, S.W. 1, ENGLAND

6-240

MOTOR LUBRICATION

Continued from page 202

most motor applications a total amount of bleeding of less than 10% in 1000 hr at 212 F and less than about 3 to 5% by weight of evaporation loss in the same period is desirable for long life. Bleeding rate of a grease can be determined by collecting the oil draining from a 10 gram sample held in a wire mesh cone in a beaker in a constant temperature oven. Evaporation loss in such a test is total weight lost from both the cone and the oil in the beaker.

Oxidation stability. Deterioration of grease by reaction with oxygen in the air is one of the chief factors determining the life of ball-bearing greases. Oxidation of the oil in the grease results in gummy materials which solidify on cooling, and in volatile products which result in a loss of fluid. Oxidation of the soap usually results in loss of the network structure. The combination of these factors often shows up as a softening grease with an increasingly rancid odor as the soap structure breaks down. This stage is followed by increasing stiffness and darkening, with finally a hard, dry, caked mass of oxidized soap being formed. Excellent oxidation inhibitors are incorporated to give extremely long oxidation life with high quality greases made with stable soaps and oils. The better greases for electric-motor service will generally not give a pressure drop in a Norma-Hoffmann bomb test of more than 20 psi in 750 hours.

Corrosion protection. Next to oxidation, the major source of chemical trouble in greases is corrosion, particularly the rusting of steel. The sodium soaps used in many greases provide excellent resistance to corrosion by absorbing small amounts of water, and also by serving as a rust inhibitor in any free water present. If large quantities of water are involved, however, the soluble sodium soap may be washed away entirely and the metal left unprotected. Protection against the grease being washed away is obtained by using insoluble thickeners such as those of the lithium- and calcium-soap types. These water-insoluble thickeners do not always act so well as soda soaps as inhibitors of rust, but they resist water washing. Generally, water washout problems are not serious in electric motors since the motor design is intended to exclude large quantities of water from entering the motor shell.

A gas turbine-generator set rated 21,500 kw will be manufactured by the General Electric Co for Electricidad de Caracas, a utility serving the capital of Venezuela.

A NEW SEAT IN A MATTER OF MINUTES...

with the new OB Regrinding Swing Check Valve

Disc and seat in the new OB Regrinding Swing Check Valve can be resurfaced in a matter of minutes . . . without removing valve from the line.

This means a saving . . . in money for the men who sign purchase orders . . . in time for maintenance men . . . in down time for production people.

You can get more details about this latest addition to the growing Ohio Brass line of bronze industrial valves by calling your distributor, or write to the Ohio Brass Company, Mansfield, Ohio, for the folder "Ohio Brass Regrinding Swing Check Valve."

Available in ten sizes . . . from ¼" to 3" for
No. 706—150 pounds WSP—300 WOG
No. 806—200 pounds WSP—400 WOG

1—Easy to remove cap.

2—Two side plugs make hinge pin always accessible.

3—Sturdy gripping lugs for wrench on pipe ends.

4—Marked for pressure.

5—Direction of flow indicated.

O-B VALVES

4619-V

"Buffalo" Pump recently furnished to large aircraft firm for handling high temperature oil.

"BUFFALO" PUMP FOR YOUR HEAT TRANSFER LIQUIDS

Specially designed for handling the high-temperature liquids now being used in vapor phase heat transfer, this new "Buffalo" Pump has already proved its reliability.

The "Q" Factor* features listed below will show you the care that has gone into its construction. For ability to handle heat transfer liquids efficiently, the performance of this pump is assured.

If you are concerned with a problem of heat transfer by a liquid medium, write us today for recommendations from our Engineering Department.

These Quality Features!

1. Extra-deep water-cooled stuffing boxes
2. Smothering gland
3. Water-cooled bearings, large oil reservoir
4. Special packing (mechanical seals optional)
5. Colmonoy-coated shaft sleeve thru stuffing box
6. Flexible all steel coupling
7. Cast steel casings and sideplates
8. Centerline support

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo" PUMPS

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE COMPANY

488 BROADWAY • BUFFALO, N.Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

My biggest boner

Chief got sick when I had been on my first firing job in a small industrial plant about a year. They gave me a fireman, put me in charge until the Chief got back.

Inspecting an hrt boiler's back end one morning before blowing down, I found two tubes leaking a little at rear head. That worried me, so I reported to the super. I told him I'd have to shut the boiler down and put in two new tubes soon as possible. I asked for a boilermaker, but the super asked me to keep going until Saturday.

No boilermaker Saturday, so the super asked me to try rolling the tubes myself. We shut down Saturday for the weekend so boiler could cool for Sunday. New fireman and I found about 10 psi on boiler Sunday morning. Being in the middle of a 3-boiler setting, it was pretty hot. But instead of blowing boiler down to get rid of pressure, I tried to save time. I also thought tubes could be rolled tighter if there was a little pressure. So I put on heavy clothing, tied a heavy cloth over my head for protection from hot brickwork, threw in some short planks to stand on, and entered.

I rolled one tube OK, was pleased with myself. With full confidence, I started on second tube. As I gave the tube roller a half turn, tube let go with a loud hissing roar. I was enveloped in a cloud of steam and hot water. I got out of that clean-out door faster than a jack rabbit. Hot water gave me a few blisters—and one good scare. I could have been scalded to death, but because the tube expander partly plugged the tube hole the hot water didn't strike me full force.

Trouble was that tube had been rolled paper-thin before. My last roll cut it off behind the tube sheet. I sure learned the hard way.

A H MOULTEN *Pittsfield, Mass.*

FLOAT VALVES

Continued from page 127

poor regulation, annoying chatter, damage from water hammer, concentrated or localized wear and excessive leakage.

To select the correct size valve consider two factors: (1) the pressure difference, or drop, between the inlet and outlet when the valve is wide open (2) the normal capacity desired. It is recommended that a valve be selected having 50% more capacity than the normal

(*Continued on page* 210)

Dowell scientist using the Optical Emission Spectrograph to get an accurate analysis of samples sent in from the field.

On the trail of scale

Analyzing chemical cleaning drain samples to determine how much scale and metal were removed is easy for this laboratory detective. Among the instruments at his disposal is this Optical Emission Spectrograph, capable of tracking down impurities as low as .0001 per cent in certain elements. Instruments like this are in constant use by Dowell scientists in their day to day search for answers to your industrial cleaning problems.

They've got an eye to the future, too. For in this completely equipped and modern laboratory, new methods and treatments are being found to make Dowell chemical cleaning even more effective. Get the full benefit of the Dowell research program. Call your Dowell engineer. He's ready to help you.

chemical cleaning services for industry **DOWELL**

A Service Subsidiary of The Dow Chemical Company
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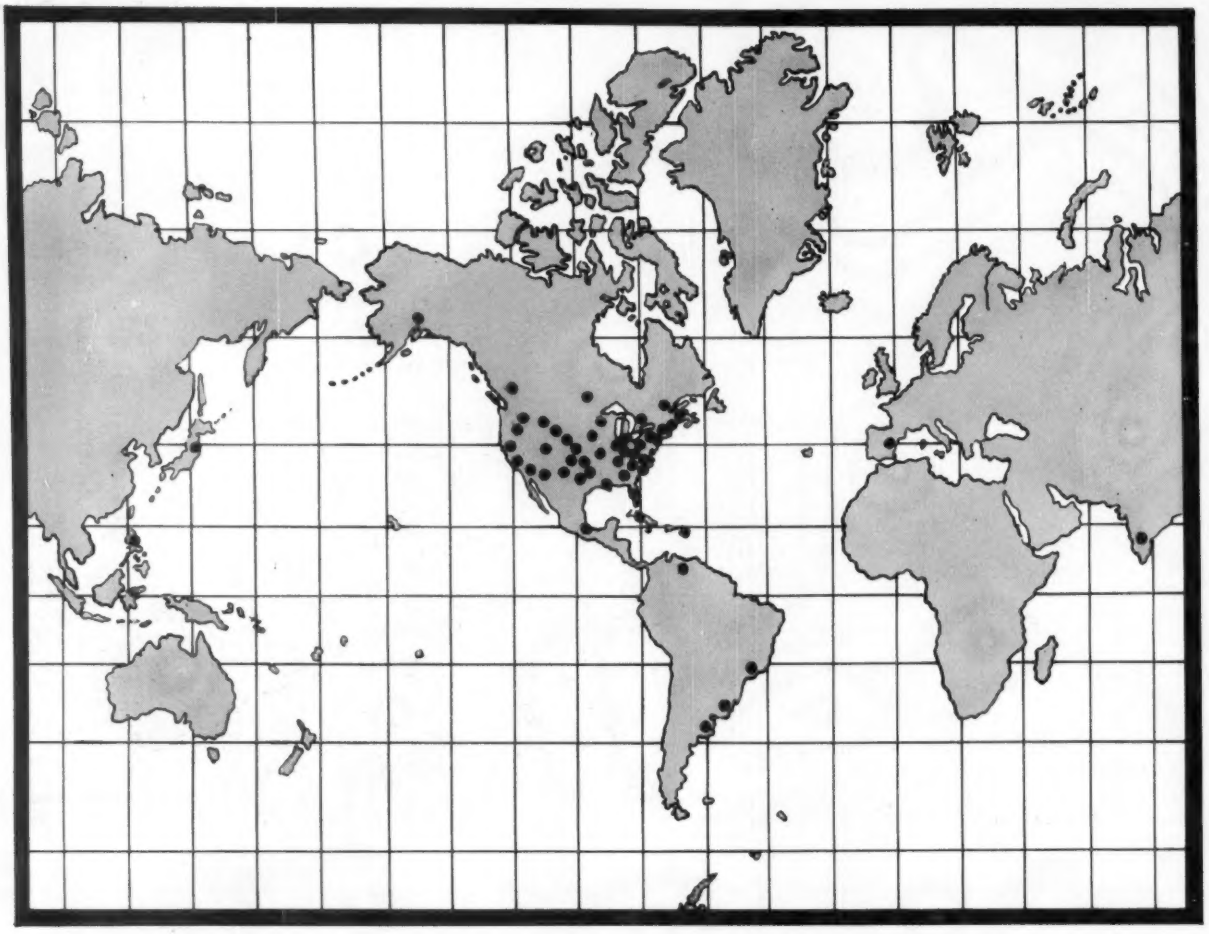


RIC-WIL offers WORLD WIDE

Service for Prefabricated Piping Systems

Over 75 field offices, both national and international are at your disposal on any project dealing with prefabricated piping systems. These field representatives offer on the spot assistance in planning, delivering and installing underground or overhead piping. A Ric-wiL representative will be glad to discuss plans involving steam, hot water or oil distribution lines . . . and he represents the world's largest supplier of prefabricated piping systems.

For the name of your nearest representative or the catalog covering the Ric-wiL line, call or write the home office.

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

SINCE 1910

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

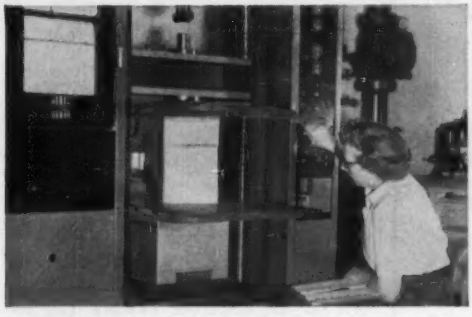
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

Research Laboratory, The Mead Corporation, Chillicothe, Ohio. Lorenz & Williams, architects, Dayton; Schweiger Heapy & Asscoiates, mechanical engineers, Dayton.

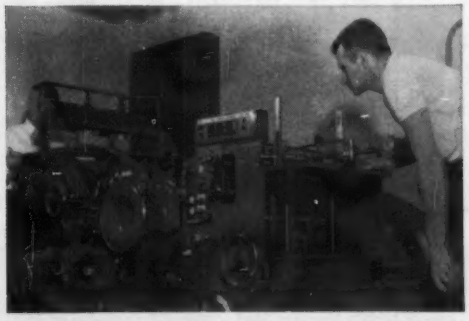
Control Flexibility—

● It's a "must" when you have diversified temperature and humidity requirements

Strategically located Johnson Thermostats operate Valves and Dampers on six large heating and ventilating units serving the spacious pilot plant laboratory.



Stress and strain breaking points of Mead carton stock are tested in a constant temperature and humidity room. Perfectly conditioned air is supplied by a built-up air conditioning unit under the highly accurate control of a Johnson Recorder-Controller.



Printing research is among other activities conducted under carefully controlled temperature and humidity conditions. Sensitive Johnson Room Thermostats, controlling mixing dampers on a central double duct air conditioning system, produce the exact conditions required.

The extensive research and development program of The Mead Corporation, one of the nation's leading papermakers, offers an interesting example of the varied temperature and humidity control needs of today's industrial buildings. At Mead, these include:

- Control of a central double duct air conditioning system serving laboratories, offices, library and public areas.
- Control of a separate air conditioning unit for a constant temperature and humidity laboratory (temperature, 75°F; rel. humidity, 50 per cent).
- Control of a variable temperature and humidity test room to maintain any temperature from 50° to 100°F and any relative humidity from 20 to 80 per cent.
- Control of combination heating and ventilating units for a pilot plant laboratory.
- Weather-compensated control of the hot water baseboard radiation system.

A Johnson-engineered Pneumatic Control System easily provides the necessary flexibility to satisfy each one of these requirements . . . *and with a precision that insures virtually waste-free heating, cooling and ventilating operation!*

This system, like the Johnson Systems in countless other industrial buildings, was designed and installed to meet the exact needs of the individual building. Regardless of how complex or diversified your control problems may be, you can count on this traditional Johnson policy to provide your plant with an equally successful, flexible control system.

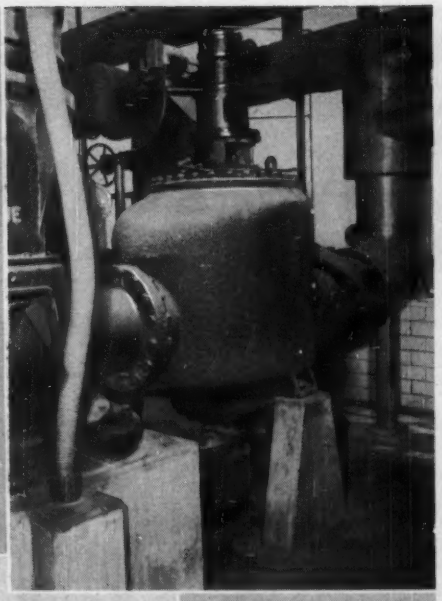
Next time you have a temperature, humidity or process control problem, talk to an engineer from the specialist Johnson organization. His recommendations are yours without obligation. Johnson Service Company, Milwaukee 1, Wisc. Direct Branch Offices in Principal Cities.

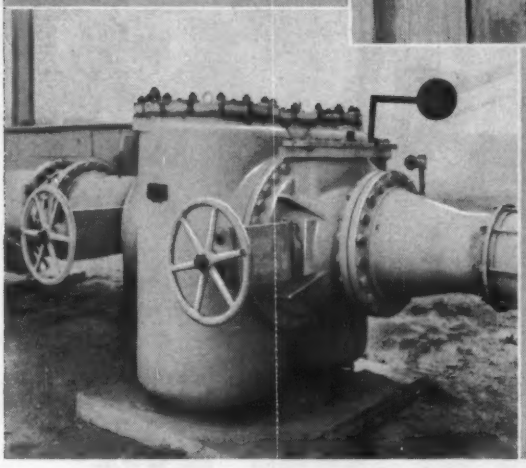
JOHNSON CONTROL

SINCE 1885

PLANNING • MANUFACTURING • INSTALLING

Favorites of Power Stations Everywhere!





One of four Elliott 20-in self-cleaning strainers located at discharge side of vertical river-water pumps at a power station.

One of several Elliott twin strainers (installed outdoors) handling cooling water at a power station.

ELLIOTT STRAINERS

Power stations all over the country are utilizing sturdy, dependable Elliott Strainers like these. They provide a continuous liquid flow with no down-time for cleaning. The type "K" strainer (upper right) cleans itself constantly and automatically. The type "A" twin strainer (lower left) offers one compartment for cleaning while the other handles the flow. When your operations call for clean, trouble-free liquids, put an Elliott Strainer on the job—whether the installation is inside or outside. For details on these and other Elliott Strainers, contact your local Elliott representative or write Elliott Company, Accessories Dept., Jeannette, Pa.

A6-1

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

FLOAT VALVES

Continued from page 206

demand. For example, if the normal requirements are 100 gpm, a valve having 150-gpm maximum capacity should be selected. This will result in less variation in water level and provide reserve capacity in case of low water pressure or unusual demand.

To assist buyer in the selection of the correct-size valve, most manufacturers make available suitable selection charts. These are based on theory and actual tests under given conditions. Such charts are found in the usual valve catalog, along with instructions for their use.

WELDING

Continued from page 123

passes on multipass work.

14 Bead contour. Smooth rippled beads produced with low-hydrogen electrodes are usually flat to slightly convex in any position. Typical bead appearance of horizontal fillets is shown in Fig. 5.

15 Penetration is shallow to medium. It is entirely adequate on any type of weld in any position when using proper welding techniques. And it is especially desirable on high carbon, sulfur bearing and alloy steels as it reduces the carbon or alloy pick-up in the weld deposit. Never use a long arc as it increases penetration.

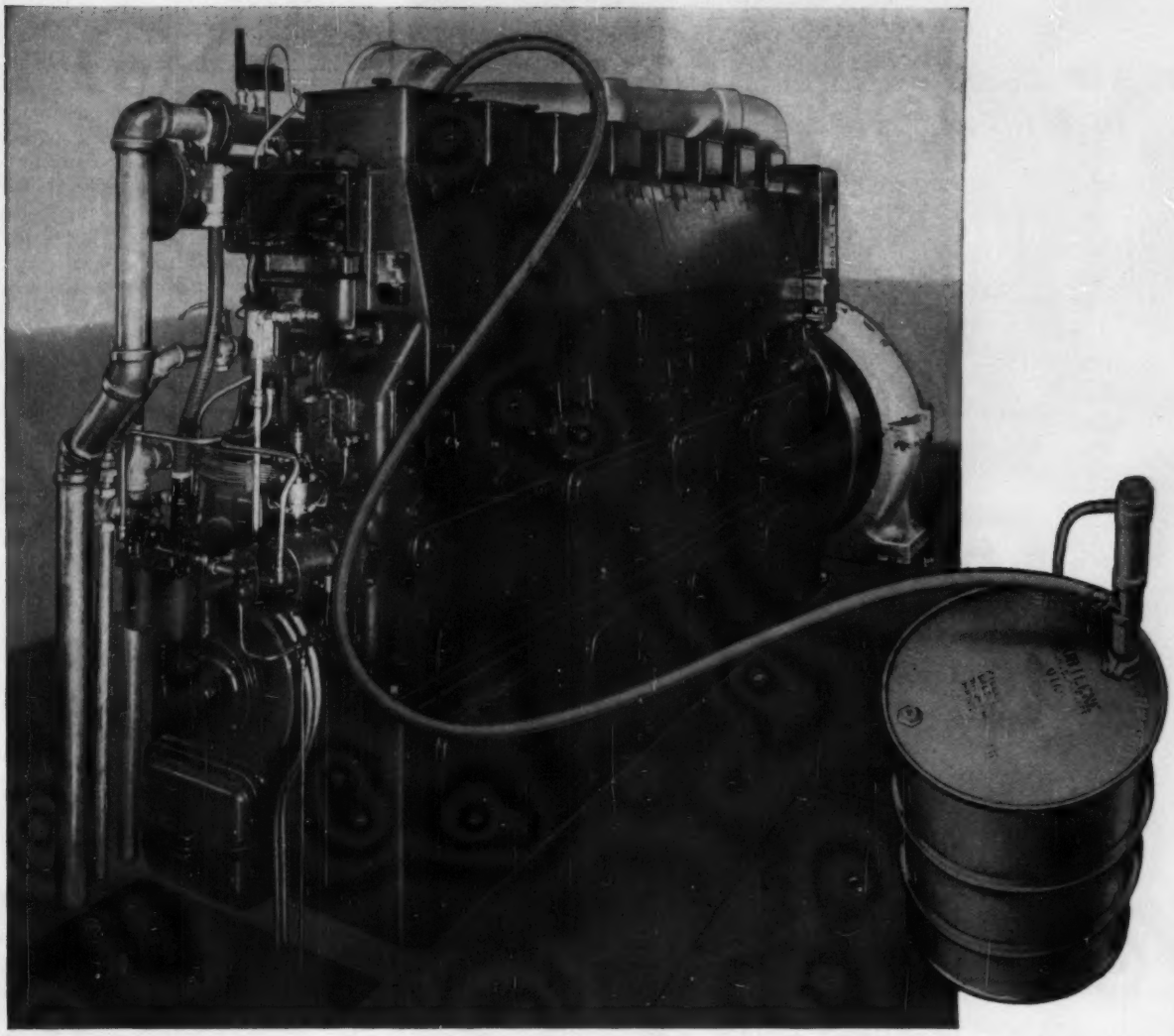
16 Undercutting is normally caused by (1) too long an arc (2) excessive travel speed (3) excessive amperage (4) improper electrode angle. Proper welding technique eliminates undercutting.

17 Porosity in low-hydrogen welds is usually caused by (1) excessive moisture in the electrode coating (2) too long an arc (3) electrode coating chipped back from the starting end, affording incomplete arc protection.

18 Unsound craters are caused by improper technique. Always break the arc slowly, drawing it back over the crater to fill. This also eliminates crater cracks or possibility of gas blisters.

19 Weld cracks may result when weld is too thin to withstand cooling stresses or when plate material has very poor weldability.

20 Preheat, stress relief. Under normal conditions, it is unnecessary to preheat when using low-hydrogen electrodes, unless you are welding some of the critical air-hardening-type low-alloy steels. Here a preheat up to 300 F may be advantageous. Stress relief has little effect on the weld's mechani-



Stops Thin-Out!

You can protect your Diesel against wear due to excessive thin-out of the lubricating oil at higher operating temperatures. Switch to Sinclair RUBILENE®, *the high viscosity index oil* proved by over 35 years in a wide variety of Diesel applications. You'll find RUBILENE holds its high film strength and reduces oil consumption . . . gives you better protection of cylinders, pistons, rings and other vital moving parts operating continuously for long periods. Your Diesel logs more full-power hours!

Switch now to RUBILENE. Regardless of the make of your Diesel, there's a member of Sinclair's famous RUBILENE or RUBILENE HD family that meets your needs exactly! Call your local Sinclair Representative or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation!*

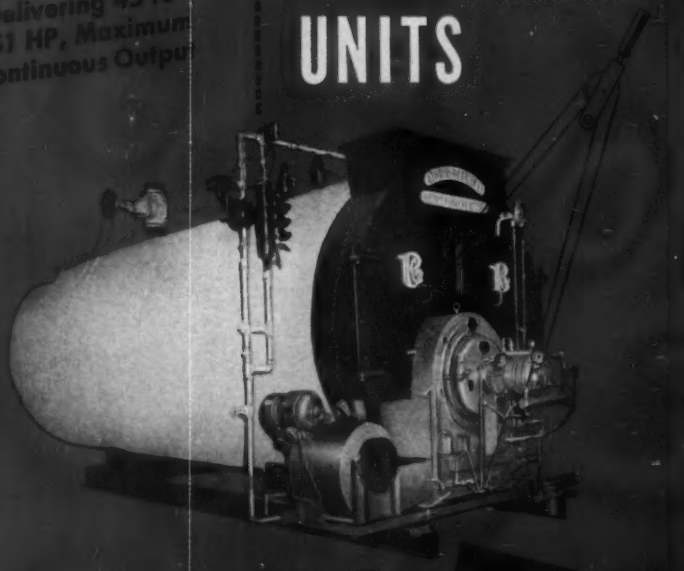
SINCLAIR

RUBILENE OILS

Self-Contained Steam Production to Fit Your Need

19 SIZES
30 to 434 HP, S.B.I. Rating Delivering 45 to 651 HP, Maximum Continuous Output

BIGELOW
BOILER-BURNER
UNITS

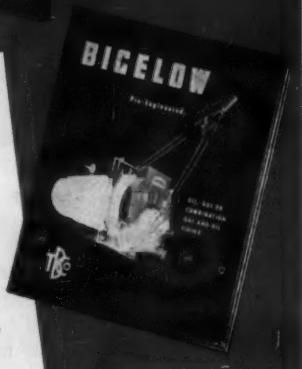


READY TO OPERATE AS SOON AS CONNECTED
Combines the boiler that closely fits your requirements with whatever top quality burner best suits your specific situation . . . Mounted on a steel base . . . Requires no special foundation, no high stack, no induced draft fan.

80% EFFICIENCY
Tubes correctly proportioned for efficient heat transfer promote 80% or greater efficiency.

RESERVE CAPACITY
8.2 square feet of heating surface per boiler horsepower, (STEEL BOILER INSTITUTE STANDARD) provides maximum continuous output reserve capacity 50% greater than nominal S.B.I. rating.

COMPLETELY AUTOMATIC — OIL, GAS OR COMBINATION GAS & OIL FIRING



Write For Your Copy Of This NEW BOILER-BURNER UNIT CATALOG

Catalogs also available on Bigelow Water Tube Boilers of various types.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

Representatives: Boston • New York • Chicago • Orangeburg, S. C. • Philadelphia • Syracuse • Detroit • Washington, D. C. San Francisco • Los Angeles • Atlanta • Milwaukee • New Orleans Petersburg, Va. • Seattle • Indianapolis • Kansas City, Mo. • Tulsa Salisbury, Md. • Greensboro, N. C.

BI-17

WELDING

Continued from page 210

cal properties. With other electrodes it is used primarily to remove defects caused by hydrogen. When a structure requires residual stress removal for optimum service, stress relieving is entirely in order and the weld metal still has excellent mechanical properties.

21 Mechanical properties are very high. The welds combine high yield and tensile strengths with excellent ductility, reduction of area and high impact strength.

22 X-ray quality. The welds readily pass the most rigid X-ray examination. They are exceptionally free of porosity and show very little tendency toward slag inclusions. Fig. 6 shows cleanliness of a cross-section of a macro-etched low-hydrogen butt weld.

REACTOR VESSEL

Continued from page 85

stainless-clad plate ever rolled by Lukens Steel Co. All plate surfaces were inspected ultrasonically for integrity of bond and backing plate. All welding operations, through thicknesses in some sections up to 10 in., had to be performed while parts were kept hot. Every weld was X-rayed by a 15-million-volt betatron. All backing plate surfaces were magnetic-particle tested against minute flaws.

The massive head and shell-flange forgings, each weighing approximately 65,000 lb, and the 10-in. thick hemispherical portions of the removable head, could not be procured with the stainless steel integrally clad. A special device for cladding the base metal by weld deposit was developed at the CE Chattanooga shops.

Final machining operations required two months on one of the world's largest boring mills. They were performed with "optical methods" to align matching machined surfaces with maximum accuracy.

The vessel is designed to withstand an internal pressure of 2500 psi at 600 F. In addition to its own 235-ton weight, the vessel will contain thermal shields, a core assembly, and other equipment weighing 100 tons.

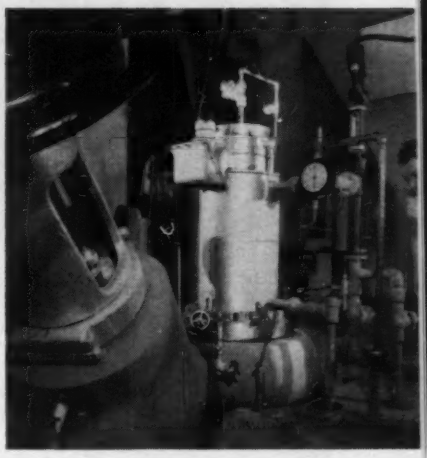
American Welding Society has formed three new sections bringing the total of active sections throughout the nation to 81. The three stations will be known, respectively, as the Mohawk Valley Section, covering the area around Utica, New York; the San Antonio Section, San Antonio, Texas; and the Stark Central Section, servicing the Canton, Ohio region.

Westinghouse "canned" pump eliminates leakage at VEPCO

Zero leakage! No injection water sealing required. Pump may be kept on hot or cold stand-by. No seal maintenance. Windings protected by nickel "cans" welded in place. No bearing lubrication.

These are advantages realized by Virginia Electric Power Company with the installation of a Westinghouse "canned" motor pump in the controlled circulation boiler system of the new Possum Point Station.

VEPCO, Stone & Webster and Combustion Engineering pioneered the power station application of this pump which was first developed to handle radioactive fluids in nuclear reactor loops. All the development work is now complete and the installation has been in actual service at Possum Point for over a year. J-57005-X



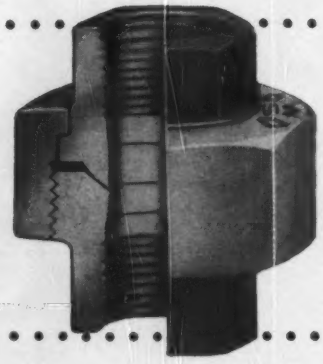
Westinghouse "canned" pump in Combustion Engineering controlled circulation boiler at Virginia Electric's Possum Point Station.

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU**!*

W-S FORGED STEEL UNIONS...

These Features are YOUR GUARANTEE of a Safe, Tight Union Connection:



1. FORGED STEEL CONSTRUCTION— ASTM A-105, GRADE 2
2. SPHERICAL-TO-ANGLE MATING SURFACES
3. ANTI-GALLING, CADMIUM-PLATED NUTS

W-S Forged Steel Unions give you the kind of protection you need in high pressure piping systems. They're designed with precision-machined spherical-to-angle mating surfaces for positive seating, free from leaks even when pipes are slightly out of line. Cadmium-plated nuts resist galling and seizing and forged steel construction gives you the extra strength you need in high pressure service.

W-S Unions are available in 3000 lb. class, sizes ⅛" to 3" in screw-end and socket-welding types. Send today for your copy of Bulletin U-1.

Sold Through Leading Distributors.

W-S FITTINGS DIVISION
H. K. PORTER COMPANY, INC.
Roselle, New Jersey

WATER TREATMENT

Continued from page 101

based on tests recommended by the American Public Health Association and the ASTM. If followed carefully they give accurate results.

Causes of errors include: (1) poor sampling (2) contamination of samples (3) use of reagents of improper type, condition or strength (4) failure to perform the tests in strict accordance with instructions.

Carefully observe the precautions for proper sampling outlined above. See that sample containers and connecting tubing are thoroughly cleaned and flushed or completely rinsed out several times with the water being collected. If possible, the sample should be at or close to room temperature.

After collection, protect samples from prolonged exposure to air. Where analysis for free CO_2 is to be made this is especially important, and may require a test set-up near the sampling point. Where dissolved oxygen determinations are being made, samples should never be exposed to the air until they are "fixed."

Preventing contamination. To prevent contamination, see that sample lines, tubing and flasks are completely free of air bubbles. New rubber tubing may also affect the test. Boil in a strong alkali solution and then thoroughly rinse it out before using new tubing for oxygen test sample collection.

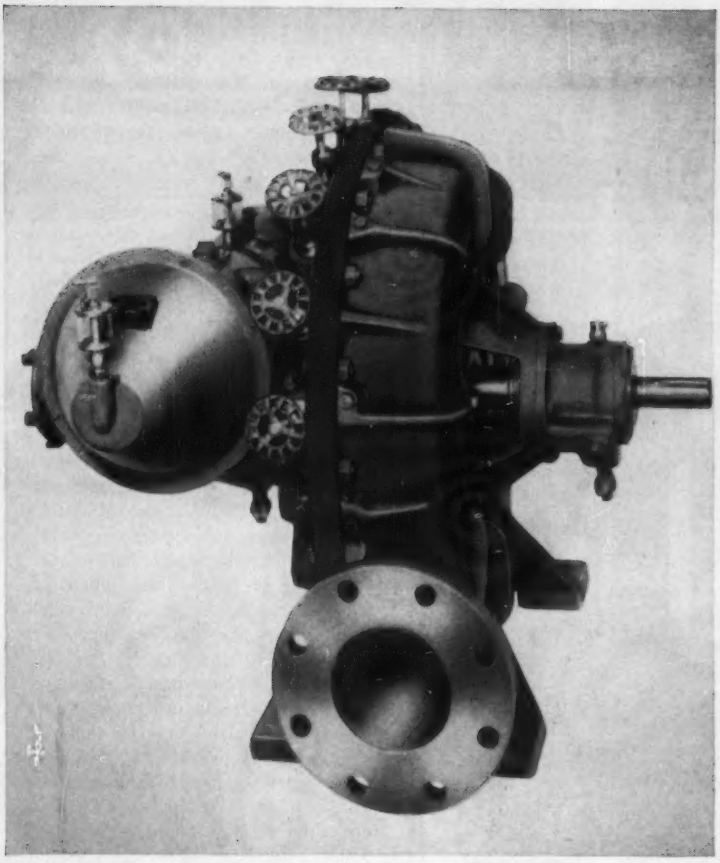
See that sampling flask stop cocks fit well. Grease them adequately but not excessively. Too much grease causes as much trouble as too little.

Unless sample is cooled to 70 F or below during collection, the vacuum that develops as the flask cools may cause leakage, contamination. Oxygen tests require temperatures below 70 F.

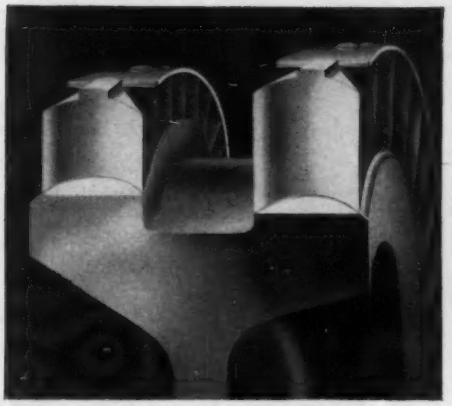
For best results, test water in a clean, cool, well-ventilated space; preferably in a special room or laboratory reserved exclusively for water testing. This set-up should have a sink with drain and a good-sized working surface, preferably of acid and alkali-resisting material, drawers or closed shelves for unused glassware, and a supply of pure condensate-type water for rinsing glassware and preparing solutions.

Purchase reagents from a reputable chemical supply house in strength and form in which they are to be used. See that containers are plainly and permanently labeled. Stoppers should fit well. Keep containers closed to prevent evaporation or contamination. If reagents are affected by light, keep them in dark bottles and store in dark cupboards.

If you leave titrating burettes set up, drain and clean them daily unless they are the closed type that protect solutions



This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel

Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
171 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

Not a Secret Vise!

Known Everywhere As Extra-handy and Rugged

RIDGID Bench Pipe Vise—8 sizes for ⅛" to 6" pipe

RIDGID

More-for-your-money pipe vises

Easy to Work With—LonGrip jaws for firmer pipe grip *plus* pipe rest for accurate threading and cutting. Built-in handy pipe bender—a time saver . . .

Years of Service—Replaceable long-life tool-steel jaws. Yoke and base of special tough malleable . . . Same quality in all RIDGID vises, yoke and chain.

Order from your Supply House!

RIDGID Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U.S.A.

WATER TREATMENT

Continued from page 214

from the air. See that burette cocks seat tightly; keep them well greased to avoid leakage. If you use a burette with several different solutions, take special care to see that the previous solution is thoroughly removed before another is put in.

If titrations depend on color change to indicate end point, daylight or fluorescent lighting of about the same quality should be used. A window or skylight facing north is best. If sunlight can shine directly on the test stand, provide blinds.

WATER ECONOMY

Usually, water cost is relatively small as compared with other plant operating costs. But the actual total of dollars spent may be sizable when the water requires treatment. If amount available or pumping or treating equipment capacity is limited, water economy is essential. Here are four practical yays to save it:

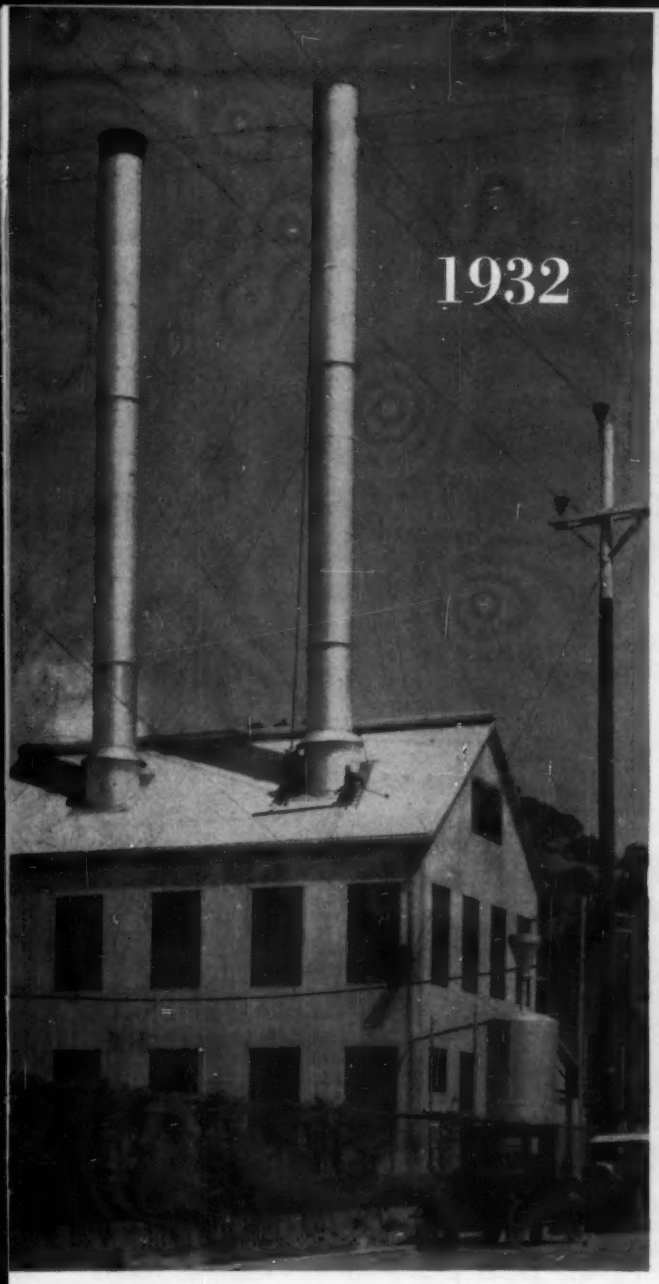
1. If you use water in surface-type coolers like hydrogen or air coolers for generators and oil coolers for turbines, use only enough to hold leaving gas or air at required temperature. Remember that dirty heat transfer surfaces need more water to hold temperature down.

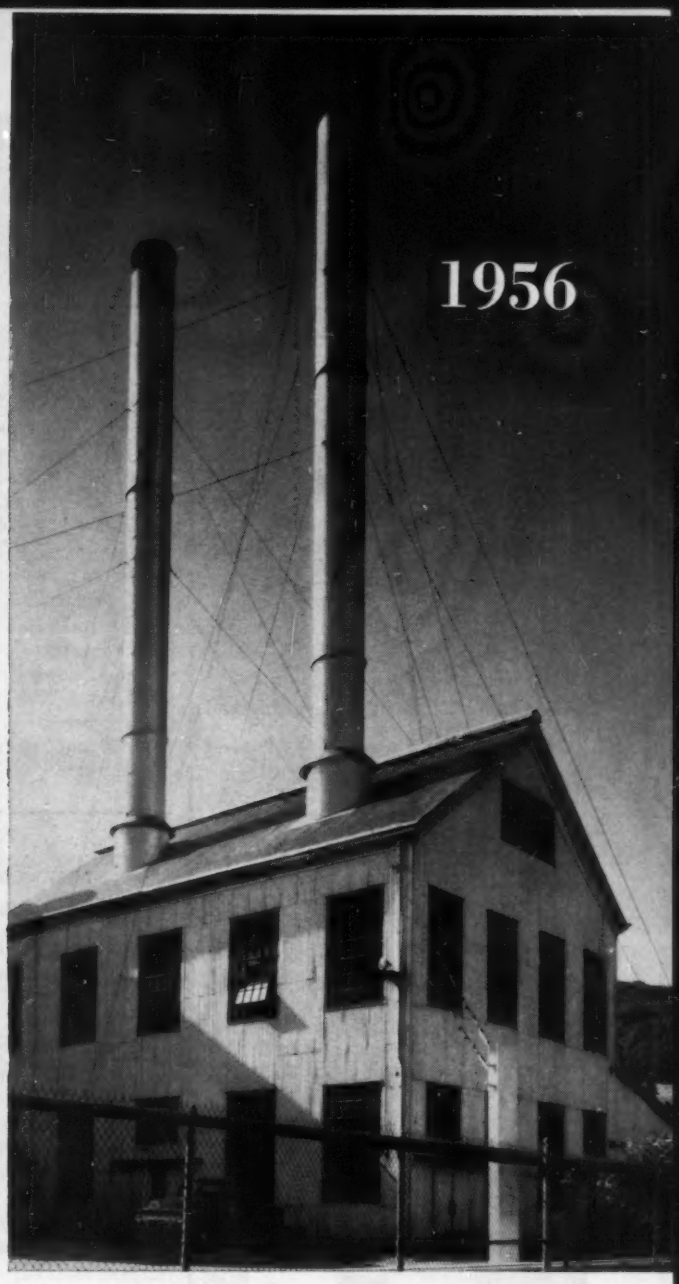
Inspect for cleanliness and observe corresponding temperature heads required. This establishes "bench marks" that you can use to see that proper heat transfer is maintained thereafter. With lower cooling water temperatures, amount required decreases rapidly. Any steps to prevent temperature rise in cooling water prior to use will save water. With very cool temperatures, quantities needed may be too small for accurate control with full line-size control valves. Here small by-pass control valves help control temperatures and save water.

2. Where water is used for cooling bearings, gears, compressors, heat exchangers, etc, there is a tendency to use excessive amounts just to be sure there will be no overheating. Up to a point, this is justified. But it is often carried to excess. Indicating thermometers on inlet and outlet water or on temperature being controlled give the operator something to work with. He can observe temperature changes and safely use water economically.

With some waters, excessive temperature rise causes scale to deposit on heat transfer surfaces. Control treatment whenever possible so that Langlier Index for both inlet and outlet temperature conditions is approximately balanced. This eliminates excessive corrosion or scale-formation in the inlet and outlet lines.

3. Reuse water where possible. First





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WATER TREATMENT

Continued from page 216

cool a low-temperature unit, then another where higher temperatures are permissible. If a cooling tower is used, collect water from plant cooling and use for tower make-up. Another use is for ash-sluicing. In some cases water that must be blown down from the cooling tower to hold desired concentration can be used for ash-sluicing.

Cooling tower make-up is often the largest single water use in a plant. Tower water conditioning and control can have a large effect on quantities of make-up used. This subject will be covered in more detail in a future chapter of this series.

4. In addition to using water to the best advantage, maintain piping and valves in good leakproof condition to avoid waste. Also, stress water economy to plant personnel. Don't let water run when it's not needed.

Atomic energy seminar to be held in Paris Jan 13-26

► A SERIES of international European-United States programs, "Atomic Energy Courses for Management," will be held in Paris, January 13-26, 1957. It is one of the first international programs to be sponsored by private industry. With the cooperation of industrial firms and atomic energy authorities in Europe, the Paris courses are being sponsored by AMF Atomics of American Machine and Foundry Co, Atomics International of North American Aviation, Babcock and Wilcox Co, International General Electric Co, Internuclear Co, Republic Steel Corp, and Sylvania Electric Products, Inc.

The seminars will be made up of lectures, demonstrations and group discussions of unclassified information and cover the full range of atomic energy developments. Subjects to be presented at the six-day course include: fundamentals of atomic energy, reactor design fundamentals, nuclear ores and processing, reactor fuel elements and metallurgical problems, together with a run down on the various kinds of reactors used for electrical power production and those used for training and research purposes.

Information on the seminar is available from the director of the courses, R Maxil Ballinger, P.O. B 169, Paris 16, France, or 145 E 49th St, New York City.

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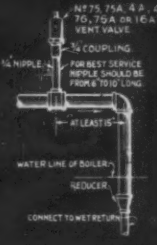
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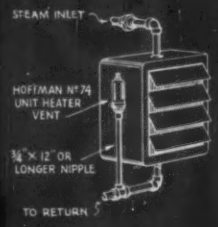
FOR BEST SERVICE NIPPLE SHOULD BE FROM 6 TO 10 LONG
AT LEAST 15
WATER LINE OF BOILER
REDUCER
CONNECT TO WET RETURN

No. 75 STEAM

The steam main must be hot first so that the heating system will get the maximum amount of heat in the miminum amount of time. The No. 75 vent with its large venting capacity lets the air out of the main permitting the heating units to function at their greatest efficiency.

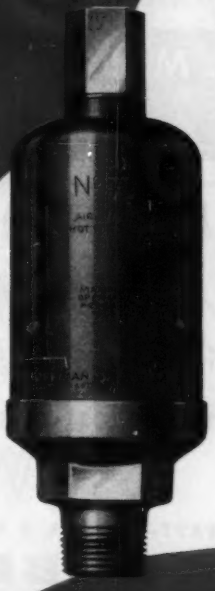
Size connection ¾" male, ½" female. Max. operating pressure 10 lbs.



No. 74
FOR STEAM UNIT HEATERS

Steam Unit Heaters must be "piping hot" to give best results. The smallest amount of air must be eliminated as fast as it accumulates. The No. 74 vent was designed to meet the unusual air problems in steam unit heaters. This vent will operate with rising, dropping or steady pressure.

Vents 300 Cu. In. of air per minute at 1 lb. and 800 C.I.M. at 10 lbs. Size Conn. ¾" male, ½" female. Max. Operating Press. 35 P.S.I.

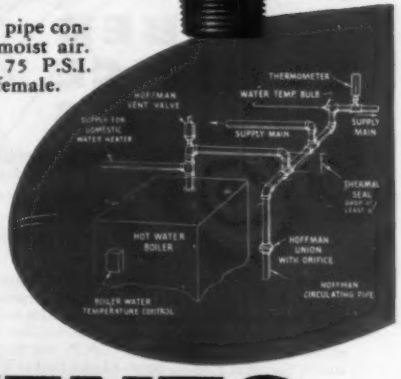


No. 79 WATER VENT

For good circulation on any water system it is necessary to let the air out. The No. 79 with its special float mechanism and rugged construction vents the air from the mains on Hot Water Heating Systems—Domestic Water Systems—Summer-Winter Units—Industrial Processes.

Tapped at the top for ¼" pipe connection to conduct away moist air.

Max. Operating Press. 75 P.S.I. Size Conn. ¾" male, ½" female.



To get top performance on Steam Unit Heaters, Steam Heating Systems, Steam Process Work, Hot Water Heating Systems, Domestic Water, Summer-Winter Units—Water Process work, air must be eliminated from the mains. The "Hoffman Big 3 Main Vents" are designed to vent the air accumulations in the main so that the equipment will function effectively.

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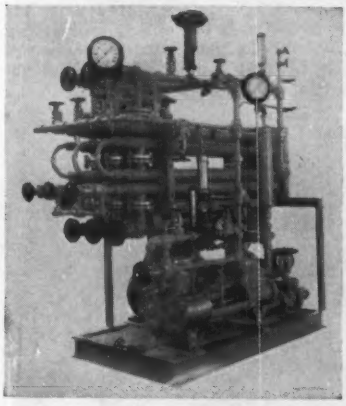

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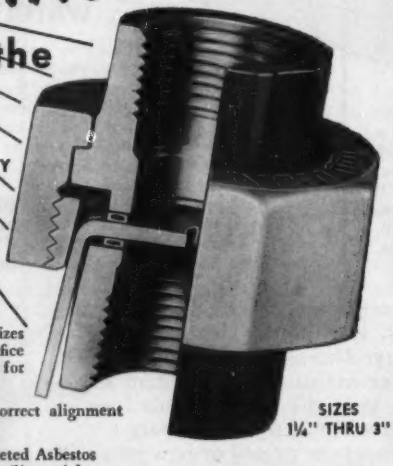

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More TECHNICAL BRIEFS

Begins on page 158

underground power station conforms to the same type of engineering judgment as is applicable in the selection of an impulse turbine rather than a Francis or Kaplan turbine. *APC paper; no number.*

Generator field tests in a one-unit hydro plant. *By H O Britt, U.S. Bureau of Reclamation.*

Purpose of this paper is to outline some of the special problems involved in performing generator field tests in a single-unit hydroelectric plant. Field tests described were performed at the Pole Hill Power Plant of the Bureau of Reclamation. This single-unit plant, which is a part of the Colorado-Big Thompson Project, is one of a series of power plants utilizing the fall of water diverted for irrigation and power purposes from the western slope to the eastern slope of the Rocky Mountains in Colorado. The generator is rated at 35,000 kva, .95 power factor, and 13.8 kv. It is driven by a 47,500-hp, 450-rpm, vertical-shaft hydraulic turbine operating under a net head of 815 ft. The plant was placed in operation on January 4, 1954, and the generator tests followed in April of that year. *AIEE paper No. 56-144.*

Pump/turbine unit 2 addition at TVA Hiwassee hydro plant. *By L R Sellers and J E Kirkland Jr, Tennessee Valley Authority.*

In 1951, TVA began studies in preparation for the installation of the second unit at Hiwassee. At that time, development of the pump/turbine had reached such a stage that a unit of this type could be considered for this project. The Hiwassee plant is well suited for a pumped-storage development, since the lake formed by Apalachia Dam backs up to the Hiwassee powerhouse and provides approximately 8700 acre-feet of water for pumping. This is equivalent to about 27 hours of pumping at rated pump capacity.

A thorough study of benefits to be derived from the installation of a pump/turbine unit as compared with the addition of a conventional turbine was made by the planning branch of TVA. Result, installation of a pump/turbine unit was recommended. This study indicated that a satisfactory return on the 26% additional installed cost of a pump/turbine would be realized due to the increased on-peak energy and generating capacity available. In addition, important but intangible

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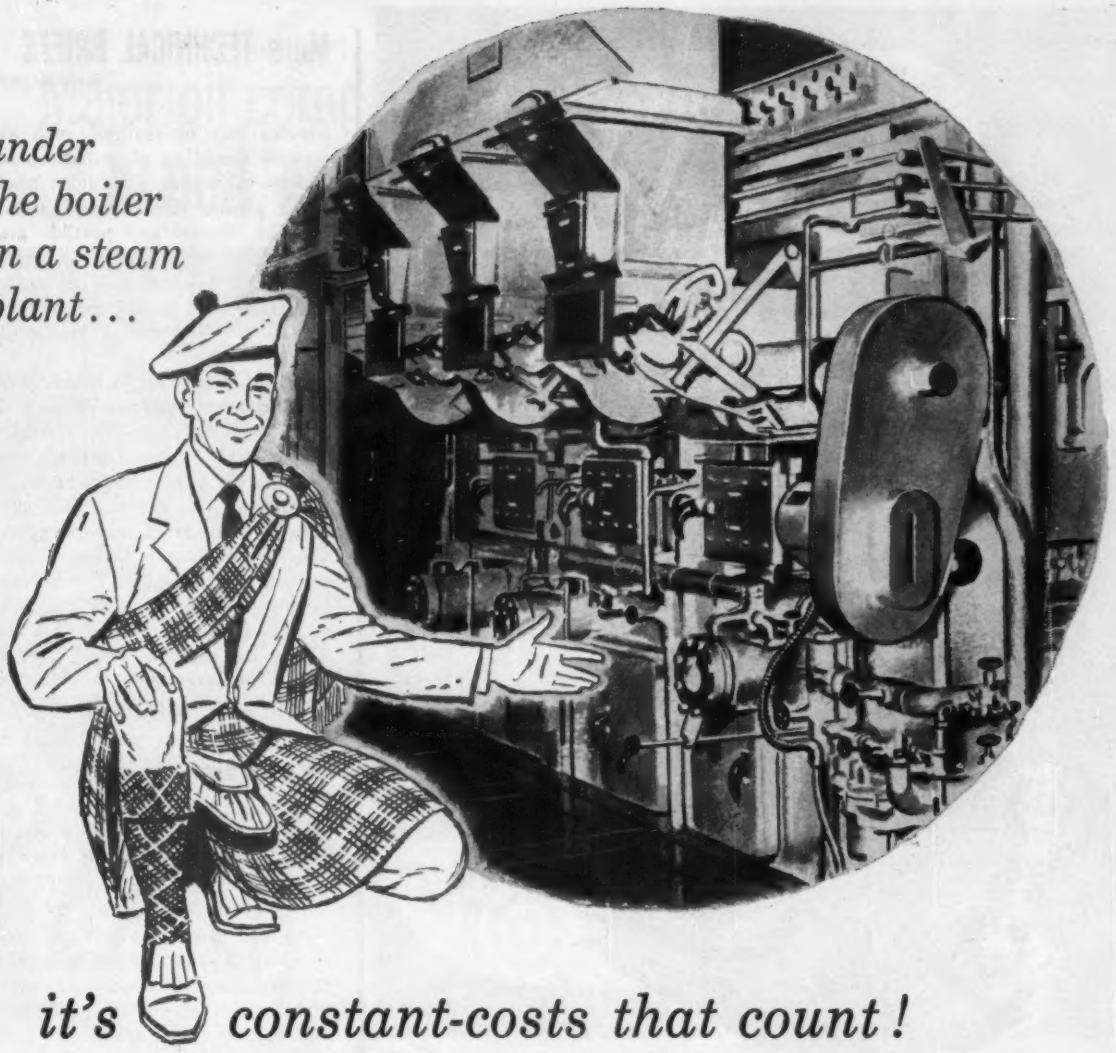
under the boiler in a steam plant...



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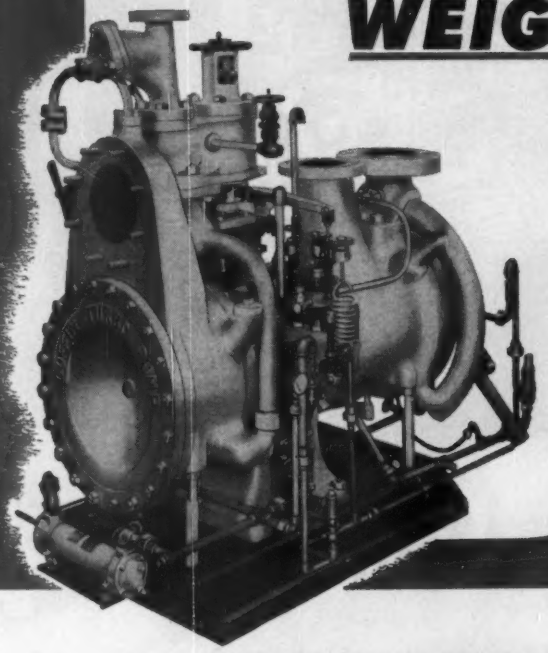

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More TECHNICAL BRIEFS

Begins on page 158

benefits may be realized, such as increased flexibility of system operation and the maintenance of higher heads at other plants. The upward trend in capacity charges and possible greater differential between peak and off-peak energy costs would also enhance the advantage of a pump/turbine type installation. *AIEE paper No. 56-145.*

What do losses cost in hydro, thermal and combined systems. *By V W Ruskin, British Columbia Electric Co, Ltd.*

The paper suggests methods of estimating two basic factors in any loss evaluation: (1) The cost of supplying one kilowatthour of loss energy in hydro, thermal and combined hydrothermal systems. (2) The investment in these different types of systems that is tied up by one kilowatt of losses. These are aspects of loss evaluation that have previously received scant attention. *AIEE paper No. 56-58.*

Welding

Inert gas-shielded welding arc behavior and metal transfer characteristics. *By G M Skinner and D M Yenni, Linde Air Products Company.*

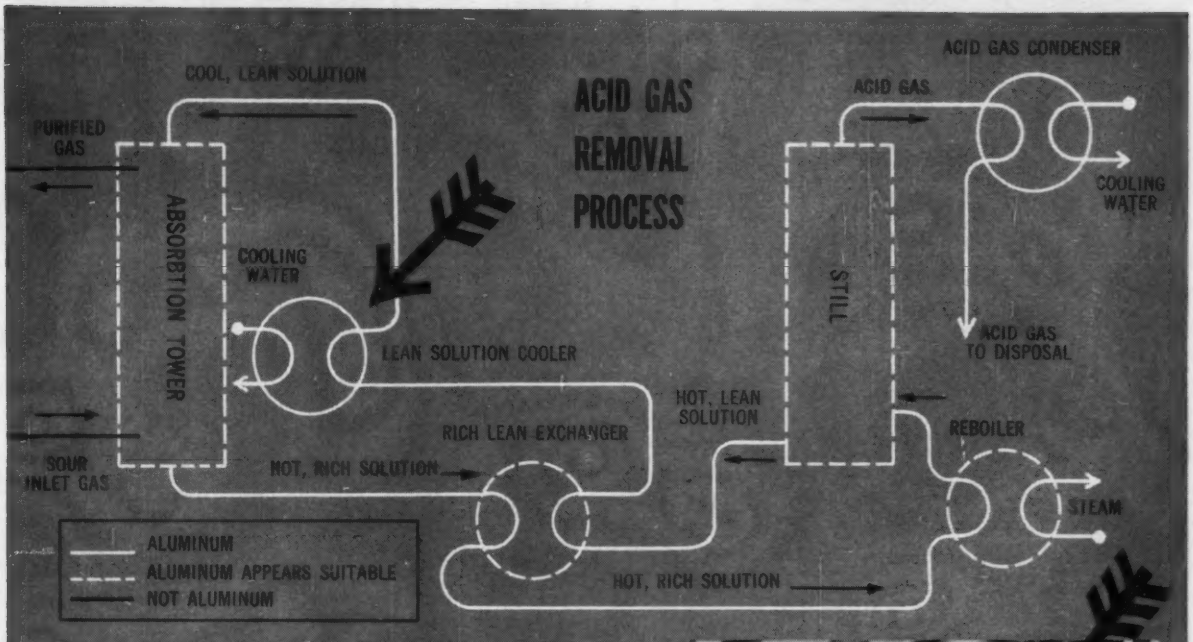
An investigation of inert gas-shielded consumable electrode arc behavior and metal-transfer characteristics was undertaken on aluminum and steel in flat vertical and overhead welding positions using argon, argon + 5% oxygen, helium and helium + 5% oxygen shielding gases. Arc and metal transfer behavior were observed with high-speed motion pictures using intense supplementary illumination to facilitate photography. Electrical behavior of the arc was examined during production of a considerable number of weld beads by recording oscilloscope traces of arc current or voltage on the high-speed pictures of the arc. Thus, relationships were observed between current transients and arc physical behavior.

Arcs shielded with argon or a mixture of argon + 5% oxygen were more stable and operated with less spatter than similar arcs in helium or helium + 5% oxygen. Although addition of oxygen to argon was desirable, addition of oxygen to helium shielding gas did not improve arc behavior or metal transfer. *AIEE paper No. 56-112.*

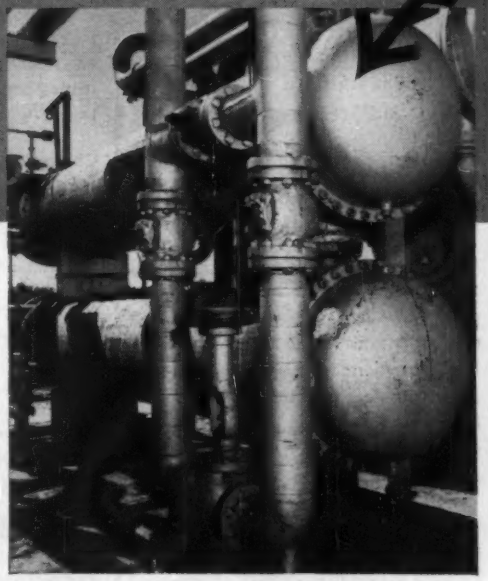
Cathode instability in argon atmosphere. *By H C Ludwig, Westinghouse Electric Corporation.*

Consumable-steel electrode arcs in

Major oil company proves corrosion resistance of **ALCOA ALUMINUM** Heat Exchanger Tubes



Flow chart shows typical acid gas removal with uses of aluminum indicated. ALCOA Aluminum alloys provide outstanding resistance to H_2S and CO_2, contaminants commonly encountered in the petroleum industry. Both aqueous amine and glycol-amine solution systems employ aluminum in heat exchanger tubes, tower internals, etc. . . . for improved service life over alternate materials . . . at far lower cost. (Photograph at right shows lean MEA solution cooler referred to below.)



Over 750 days' exposure to corrosive gas contaminants has proved to a major oil company the superior resistance of ALCOA Alclad Heat Exchanger Tubes. Used in the lean MEA solution cooler of a Girbotol Gas Treater, the tubes are exposed to a solution carrying 10 grains of hydrogen sulfide per gallon at the rate of 350 gallons per minute. After more than two years of service, the aluminum tubes are virtually unaffected.

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More TECHNICAL BRIEFS

Begins on page 158

argon atmospheres of controlled impurity possess a type of cathode instability which is affected by electrical, chemical and geometrical parameters. A study of cathode instability and the accompanying fluctuations in arc voltage and current have been made. Purpose of this paper is to discuss these manifestations as related to welding of structural carbon steel. *AIEE paper No. 56-110.*

Corrosion

A study of galvanic corrosion. *By James T Waber.*

Distribution of potentials within a corrodent has been analyed using several geometric arrangements of electrodes which lie in a common surface. Polarization has been assumed to follow Wagner's useful relation as it varies from point to point on the electrode in response to local corrosion current. Distribution of the corrosion attack over the anode was also studied.

Two important results are: (1) There is a size effect—detailed behavior depends to a great extent on whether electrodes are larger or smaller than Wagner's polarizaton parameter. (2) Potential of a galvanic couple depends on relative amounts of the two electrodes and on their open cell potentials. *NACE paper No. 25.*

Cathodic protection of certain semi-marine pipelines. *By B J Whitley Jr.*

This paper presents a practical discussion of cathodic-protection program that was applied to a system of three pipelines; twelve, ten and six-inch that interconnect and extend from just south of Refugia, Texas into Corpus Christi Bay between Ingleside and Port Aransas, across Shamrock Island to Mustang Island.

Steps taken to polarie the line, apply cathodic protection, survey and mitigate interference problems are discussed to show how the lines are now being protected. *NACE paper No. 26.*

Performance tests on pipeline coatings. *By H W Wahlquist.*

Results of performance tests on a variety of pipeline coating materials are summarized. Included are measurements of coating resistance and current collected by buried pipe specimens under continuous cathodic protection over a period of eight years. Some observations relating to effects of cathodic

Directions for ordering papers on page 226

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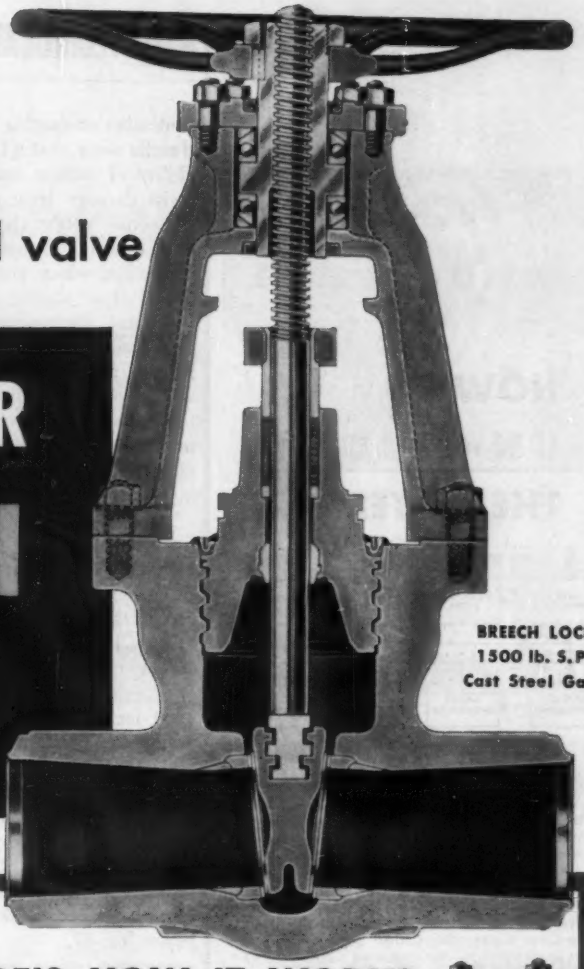

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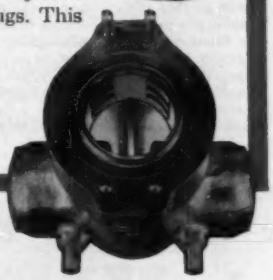

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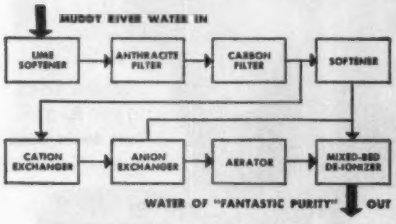

This block diagram shows a typical arrangement for a power company steam plant that must draw its boiler feed water from a nearby muddy river. The Lime Softener takes out suspended solids, turbidity, alkalinity, and organic matter; the Anthracite Filter removes any remaining turbidity; the Carbon Filter removes the chlorine; the Softener provides process water; the Cation and Anion Exchangers remove the dissolved solids such as carbonates, sulfates, and chlorides; the Aerator takes out most of the CO_2; and the Mixed-Bed De-Ionizer eliminates the remaining 4 or 5 ppm of solids, silica, and 5 ppm of CO_2 — to produce water of "fantastic purity."

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More TECHNICAL BRIEFS

Begins on page 158

protection on coating life are presented. Results show that (1) a wide range in ability of various coating materials to resist damage from excessive cathodic protection potentials exists (2) life of most coatings is increased by cathodic protection when potentials are maintained at or slightly above the protective point. Pronounced differences were also observed in ability of various coatings to resist damage from soil stress and weathering. Beneficial effects of shields and reinforcements in improving ruggedness and overall performance of pipeline coatings are shown by a number of tests. *NACE paper No. 28.*

Cathodic protection of radiant heating pipes. *By L C Wasson.*

To apply cathodic protection to radiant heating pipes, it was necessary to install distribution anodes through a concrete door. Since some 500 anode clusters were installed in a space 300 x 1200 feet some unusual techniques of application had to be developed to make the installation feasible. These techniques, along with the reasoning that led to their use are described. Also mentioned are some of the problems encountered in trying to determine if and when complete protection of the system was obtained. *NACE paper No. 47.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

American Power Conference, 18th annual meeting. Identified by initials APC and obtainable through purchase from Director, APC, Illinois Institute of Technology, Chicago 16, Ill.

National Association of Corrosion Engineers, 12th Annual Conference. Identified by initials NACE. For further information contact NACE, 1061 M & M Building, Houston 2, Texas.

Diesel Engine Division of The White Motor Company has received an order for 27 Superior Diesel Engine power generating units for new U.S. Air Force bases in Spain.

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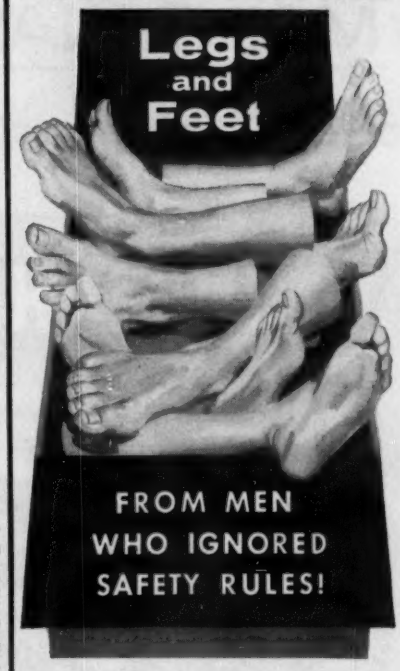

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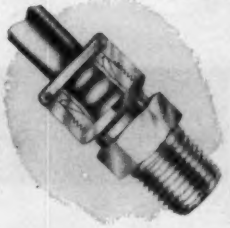

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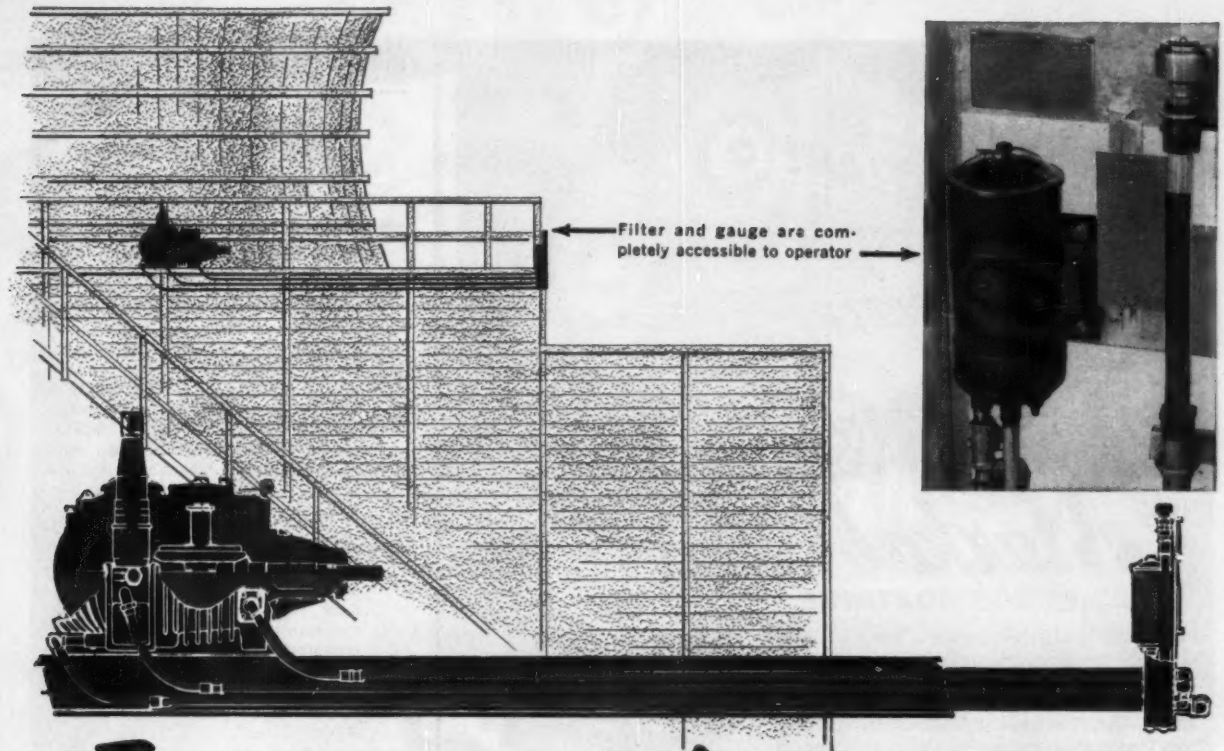

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Begins on page 171

one motor and line drawings showing variety of frame sizes. Allis-Chalmers Manufacturing Co, 952 70th St, Milwaukee, Wis.

13 **Isolated phase buses** are subject of 20-p illustrated bulletin GEA-5460A. Contains descriptive, application and dimensional information. General Electric Co, Schenectady 5, N. Y.

14 **Power system** planning is subject of two bulletins, WP-1099-B66P and W-200-B7P. Includes information on power plant installations, new products and engineering ideas. Worthington Corp, 426 Worthington Ave, Harrison, N. J.

★ **Transformer** instruction is subject of 8-p illustrated bulletin. Covers installation, operation, component parts, maintenance and inspection of distribution type transformers. ★Request direct on company letterhead from Moloney Electric Co, Advertising Dept, 5390 Bircher Blvd, St. Louis 20, Mo.

15 **Circuit brenkers** are described in 4-p illustrated bulletin 5042. Provides descriptive and application information. I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Philadelphia 30, Pa.

16 **Transformers** and substations are subject of 10-p illustrated bulletin 655. Contains applications, sizes and types. Sorgel Electric Co, 838 W National Ave, Milwaukee 4, Wis.

17 **De power supplies,** constant voltage, are described in 8-p illustrated, pre-punched bulletin CV-235. Contains technical data, mechanical and electrical specs and performance data. Sola Electric Co, 4633 W 16th St, Chicago 50, Ill.

HEAT EXCHANGERS

18 **Heat exchangers** of the fin-tube type are described in 8-p illustrated bulletin FH-3. Includes table of dimensions, type designation table, finside coefficient and pressure drop charts for all sizes of exchangers. Alco Products, Inc, P.O. Box 1065, Schenectady, N. Y.

19 **Hydraulic fan drive** for air cooled heat exchangers and cooling towers is described in 6-p illustrated bulletin 3009. Contains performance curves useful for selecting unit for specific applications. De Laval Steam Turbine Co, 852 Nottingham Way, Trenton 2, N. J.

SAFETY EQUIPMENT AND MATERIALS

20 **Materials dispensing** equipment is described in 15-p illustrated, pre-

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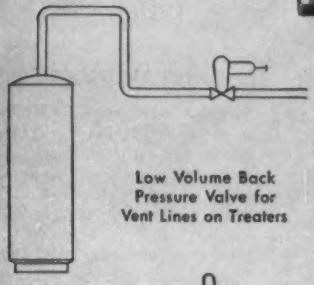
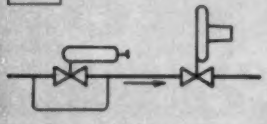


Low Volume Back Pressure Valve for Vent Lines on Treaters



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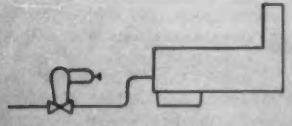

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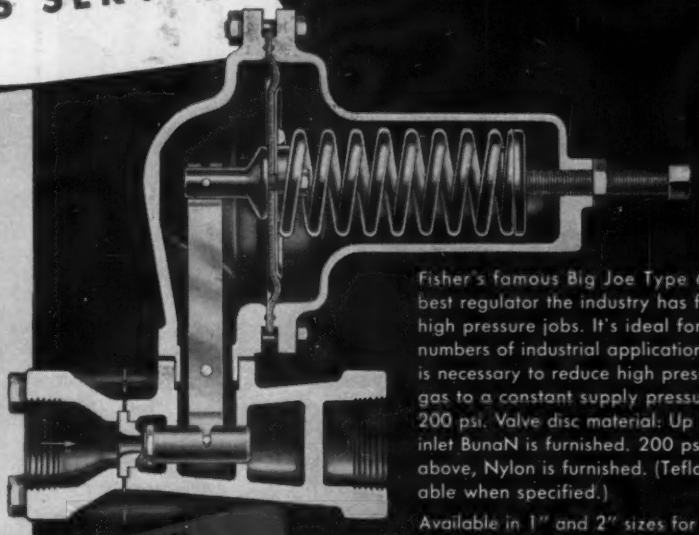

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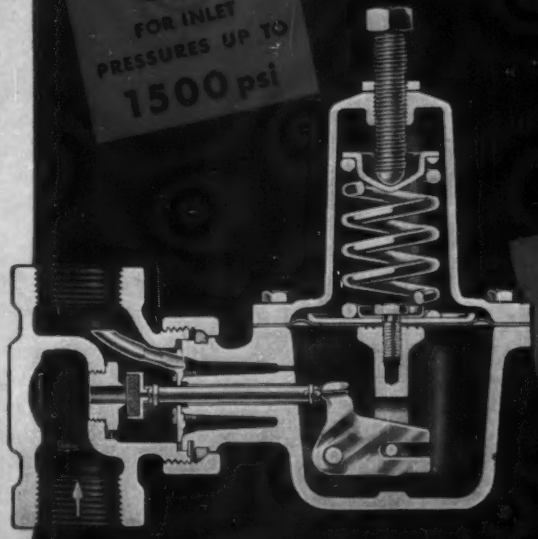

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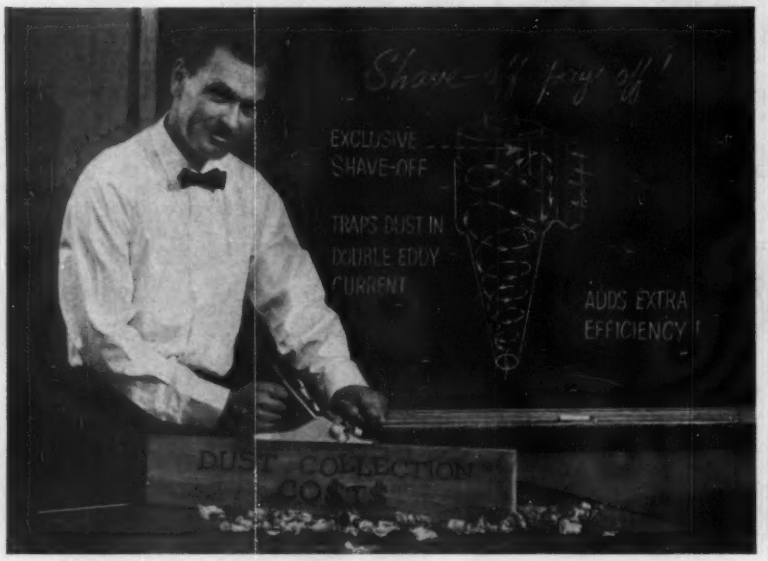

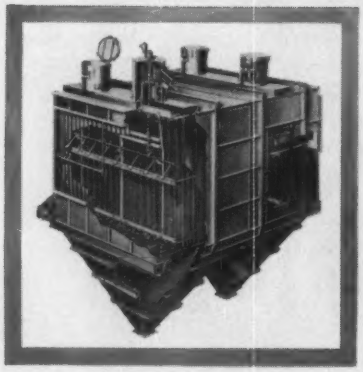

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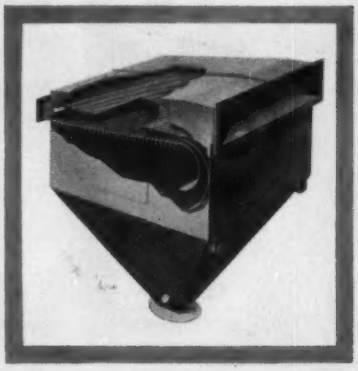

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Begins on page 171

punched bulletin 41. Contains selection chart, applications and information on accessories. Lincoln Engineering Co, 5799 Natural Bridge Ave, St. Louis, Mo.

21 **Mechanical packings** are subject of 24-p illustrated catalog 56. Includes 246 types, dimension table and recommendation charts. Belmont Packing & Rubber Co, Butler & Sepviva Sts, Philadelphia, Pa.

MAINTENANCE EQUIPMENT & MATERIALS

22 **Underground pipe** protection is subject of 24-p illustrated booklet, *Tape It Easy*. Provides photographs and instructions for taping fittings, coverage table with recommended tape widths for various pipe sizes. Minnesota Mining and Mfg Co, 900 Fauquier St, St. Paul, Minn.

23 **Spray lubriention systems** for open gearing and slide surfaces are described in 8-p illustrated bulletin 60-A. Offers descriptions of manual and automatic systems and component equipment with schematic layouts as well as actual application views. The Farval Corp, 3249 E 80th St, Cleveland 4, Ohio.

MATERIALS HANDLING

24 **Swaged wire rope** assemblies are described in 24-p catalog 5601. Gives all dimensions, drawings, capacities, sizes of both terminals and wire rope. Macwhyte Co, 2936 14th Ave, Kenosha, Wis.

25 **Conveyor pulleys** are subject of 12-p price catalog CP-80. Gives specs and prices for original installation or replacement on package production line, portable and general conveyor systems. Includes engineering drawings, illustrations and descriptive matter. R & J Dick Co, Inc, 1 Sade St, Passaic, N. J.

26 **Continuous mixer** and unloader is described in 6-p illustrated data sheet Uc. Illustrates two sizes and four styles of equipment. Contains six line diagrams with dimensional and construction tables. The Allen-Sherman-Hoff Co, 259 E Lancaster Ave, Wynnewood, Pa.

METERS AND INSTRUMENTS

27 **Meters** and thermo-hydrometers are subject of 8-p illustrated bulletin G-3. Describes hydrometers with scales in percentage of alcohol, API, Baume, Brix, percentage of calcium chloride, proof, salt, specific gravity and Twaddell calibrations. Thermo - hydrometers with scales in API, Brix and specific gravity calibrations are illustrated and described. Precision

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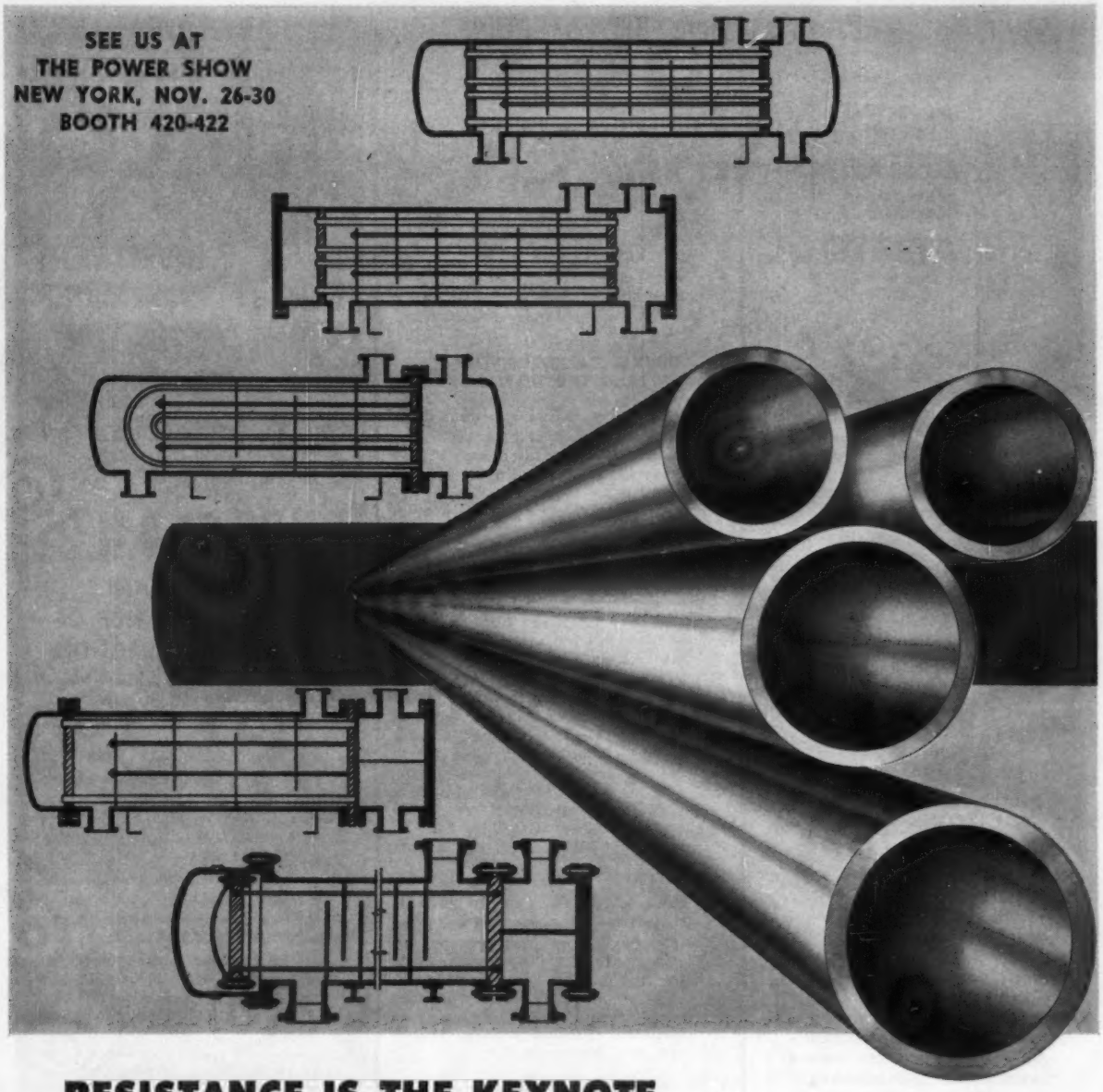

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Thermometer & Instrument Co, 1434 Brandywine St, Philadelphia, Pa.

28 **Radiamatic pyrometer** is described in 24-p illustrated catalog C 93-1. Contains construction features, general specs, accessories, typical applications, charts and scales. Minneapolis-Honeywell Regulator Co, Wayne and Windrim Aves, Philadelphia, Pa.

PIPING, VALVES, FITTINGS AND SPECIALTIES

29 **Diaphragm valves** are subject of 12-p illustrated catalog 100. Contains applications and specs. Three basic types of valve operation are shown and dimensional specs are given. Hills-McCanna Co, 3025 N Western Ave, Chicago, Ill.

30 **Butterfly valves** are subject of 40-p illustrated catalog B-2. Includes pressure drop and flow tables, conversion tables, theory and application and recommended materials. Henry Pratt Co, 2222 S Halsted St, Chicago 8, Ill.

31 **Pipes, fittings** and valves are subject of 8-p illustrated bulletin 10050. Explains how pipe is installed, reviews product applications and describes physical properties. Includes chart listing common chemicals that can be handled. B F Goodrich, Akron, Ohio.

32 **Bellows** are described in 20-p illustrated catalog 155. Contains information on applications, design considerations and standards for metallic blowers. Specific details on using bellows, manufactured from various metals, are included. Flexonics Corp, 1301 S 3rd Ave, Maywood, Ill.

PUMPS

33 **Pumps** for varied liquid-transfer installations are described and illustrated in 4-p bulletin 1323. Contains a selection guide and an analysis of cost per gallon pumped. Pump Engineering Co, 2011 S Santa Fe Ave, Los Angeles 21, Calif.

34 **Reciprocating pumps,** horizontal, forged steel cylinder, steam driven, are discussed in 4-p illustrated bulletin 146A. Contains specs, sizes, capacities, sectional views. Dean Brothers Pumps, Inc, 323 W 10th St, Indianapolis, Ind.

35 **Pumps** are subject of 20-p illustrated catalog. Contains selection tables, information on functional design, speed and gallonage considerations, a list of liquids with viscosities and specific gravity, permissible percentages of speed for liquid and mechanical specs. Wayne Pump Co, 212 Tecumseh St, Fort Wayne, Ind.

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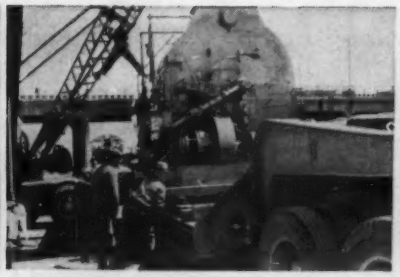
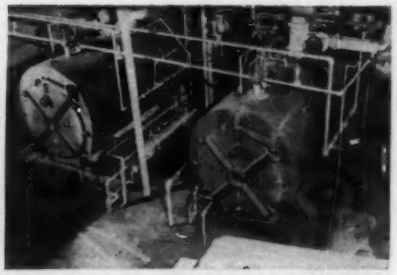
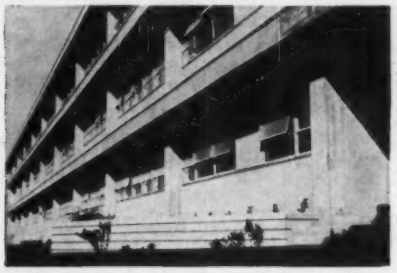
300 hp Cyclotherm with 1 to 6 modulation operates with no loss of efficiency at a towel supply company.



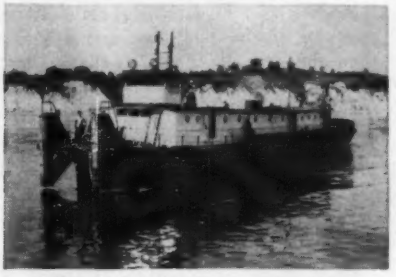
New, 750 hp Cyclotherm is most powerful package boiler ever developed. Delivers 26,000 pounds of steam per hour to a Denver linen supply company.



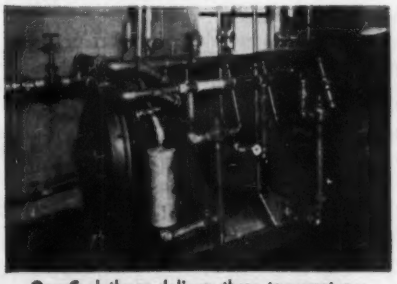
Annual savings of over $18,000 in labor, fuel and insurance costs, by installing two 125 hp Cyclotherms in a New England manufacturing plant.



Reverse Boiler Water Flow on two, 60 hp Cyclotherm step up heating efficiency at an educational center.



Shipboard boiler room was too small for a conventional boiler, but Cyclotherm fit with room to spare in the *Sinclair Chicago*.



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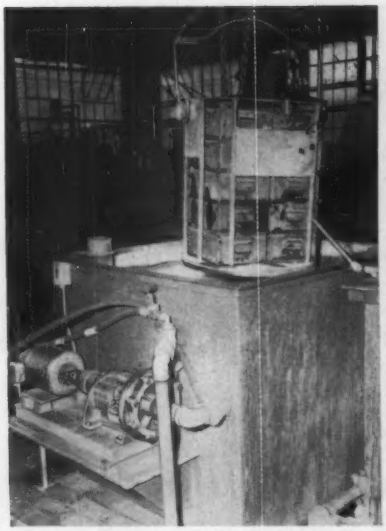
CYCLOTHERM

When you have a problem in steam or hot water generating, chances are Cyclotherm will be *your* answer, too. These are but a few of the hundreds of applications where Cyclotherm has outshown other boilers in economy, space and performance. Operating on the patented Cyclonic Combustion principle, Cyclotherm gives intense, but controlled heat through the length of the furnace. Hot spots and heat-retarding scale are eliminated by distributing the flame evenly, without impingement. In up to ⅔ the space required by an ordinary boiler, you can install a Cyclotherm. Its simple, streamlined construction saves up to 50% of maintenance costs, and delivers a guaranteed minimum of 80% efficiency in only 2 passes.

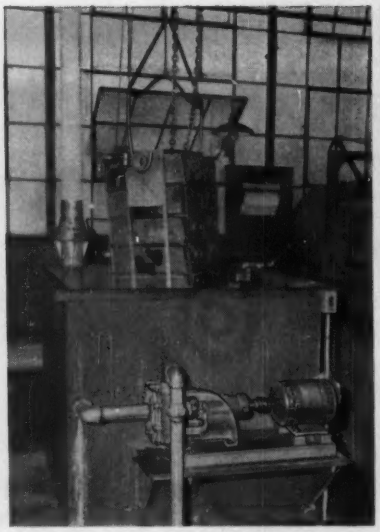
The Cyclotherm Steam or Hot Water Generator is delivered complete, ready to go with five simple connections. No additional insulation or instrumentation is needed, and you supply only a simple flue—not a costly stack. Cyclotherm models range from 18 to 750 hp, from . 5 to 200 psi. Larger units regulate firing ratio from 30% to 100% of rating without losing efficiency. All models are factory tested, and are warranted free of all defects in workmanship or materials for one year. *For an 8-page booklet describing over 30 different Cyclotherm installations, write today to Dept. 2531.*

CYCLOTHERM DIVISION National U.S. Radiator Corp., Oswego, N. Y.

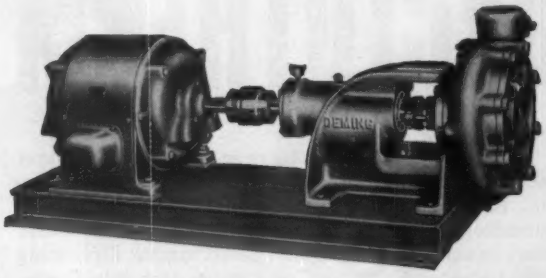
See the Cyclotherm Exhibit—22nd Annual National Power Show ASME, Nov. 26 to 30. Booth 506, N. Y. Coliseum



Deming Fig. 4011 Centrifugal Pump delivers 180° caustic solution at rate of 100 g.p.m. against 46-foot head for degreasing trays of hand tools.



Same load of hand tools is rinsed in wash water tank served by another Deming Fig. 4011 Centrifugal Pump at 100 g.p.m. against 46-foot head.



What's *Your* job for this Versatile Deming Pump?

Champion de Arment Tool Company, Meadville, Pa., has a dual job for two identical Deming Fig. 4011 End Suction Centrifugal Pumps. "CHANNELLOCK" pliers and other famous hand tools are manufactured by that company.

Degreasing and rinsing trays of these tools is the dual job serviced by the Deming Pumps, as illustrated in the above views. *What's YOUR job for this versatile Deming Pump?*

Optional features of Fig. 4011 make it readily and *economically* adaptable for handling a wide variety of liquids, including many corrosive materials.

Bulletin No. 4011-A gives all the facts. Ask for your free copy.

THE DEMING COMPANY • 547 BROADWAY, SALEM, OHIO

DEMING

INDUSTRIAL PUMPS

REPORTS from the FIELD

Begins on page 156

Cross Channel Cable — Continued

Cost of cable-laying is estimated at $11 million, to be shared by British Central Electric Authority and Electricite de France. Single cable to be used will be capable of transmitting between 120,000 and 150,000 kw at 200,000 v by dc.

In response to queries from POWER, M. Ailleret, who heads Electricite de France's new project, said that questions on the size of the cable and the company that will make it, are still under study. This information is scheduled for release at the end of the year.

Research Moves Ahead — Continued

In July 1955, POWER reported from London that "fuel cell research has shown promising results at Cambridge University." A successful laboratory working model had been set up that had run over 1000 hours. Plans were being made for a prototype cell with an 8-kw output.

Today researchers at Parma, such as the one in photo, right, p 156, foresee a day when fuel cells, operating on gas by-products, will furnish auxiliary power in chemical plants, or act as power supplies for remote stations, running several years without attention.

In June of this year, p 86, POWER asked, "Is electroluminescence the next major advance in general lighting?"

The answer as given by Westinghouse would now seem to be a resounding "Yes."

Electroluminescence is the giving off of light by phosphors coated on a glass panel which is treated to conduct electricity. When electricity is applied, panel lights up.

In June, POWER found that this light source was too inefficient for general use but predicted that if proven practical it might make a contribution greater than the fluorescent.

Westinghouse bears this prediction out. Spokesmen there say that "efficiency limit is four times as high as that of the best fluorescent lamps of tomorrow."

In mid-September, Westinghouse gave weight to its words when it unveiled a room illuminated by 112 glass panels giving off a soft green, shadowless light.

As part of the demonstration, the first electroluminescent flashlight was displayed, photo, left, p 156. Powered by a 25-v battery, it contains a special transistor to provide the type of elec-

the BIGGEST NEWS in expansion joints since the equalizing ring

New Zallea Duo Equalizing Expansion Joints represent a major advance in expansion joint design. Years of continuous research have resulted in an expansion joint that lasts longer, is substantially smaller and lighter, and has greater stability than any other available expansion joint.

Longer life. Hundreds of cycling tests to destruction prove that Duo Equalizing Expansion Joints last as much as 40% longer than Self Equalizing Expansion Joints at the same pressure and movement.

Lighter weight. Weight of the expansion joint has been reduced as much as one-third. Handling and installation are easier.

Shorter length. Overall length has been reduced as much as 30%.

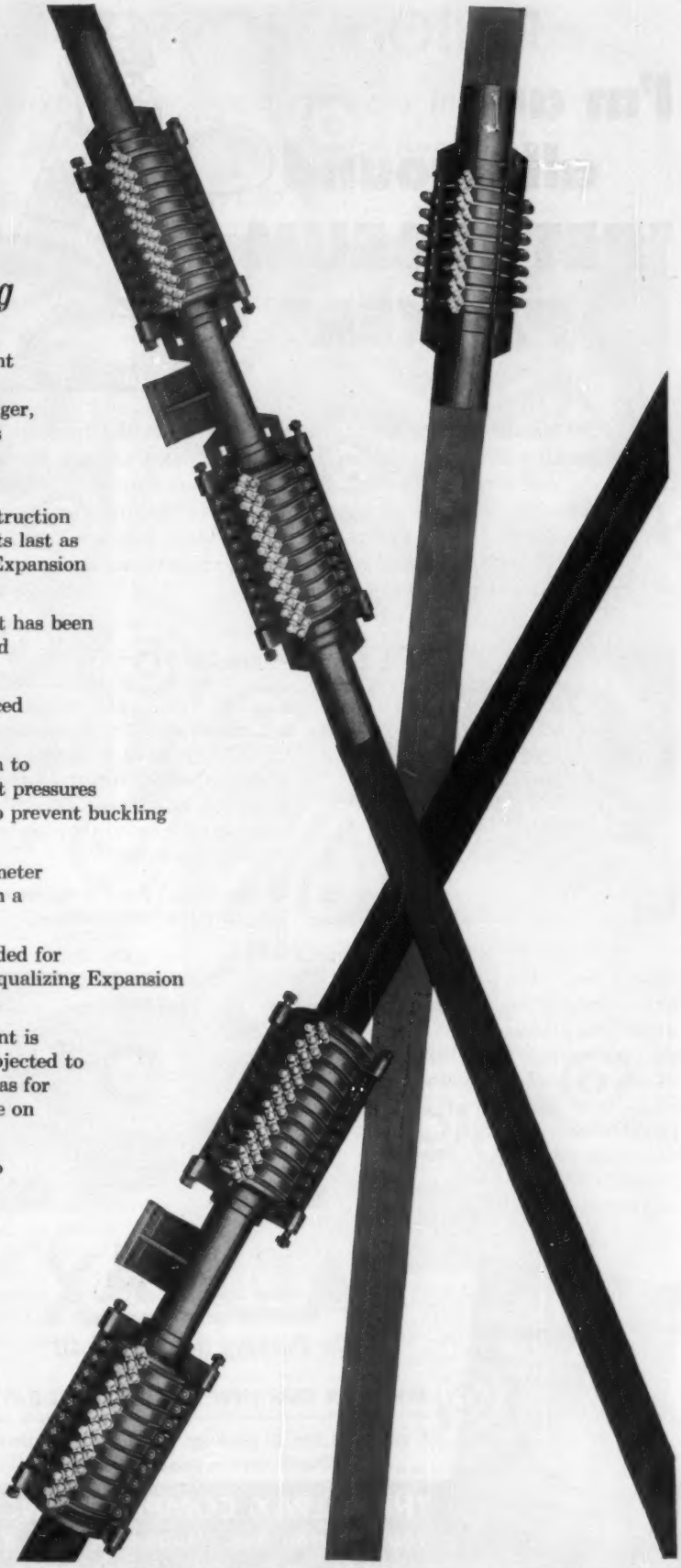
Greater stability. Reduction in ratio of length to diameter means higher stability at high test pressures —no need to support the expansion joint to prevent buckling during hydrostatic testing.

Sizes and traverses. Sizes range from 3″ diameter to 72″ diameter, for traverses up to 7½″ in a single unit or 15″ in a double unit.

Working pressures. Although normally intended for 150 and 300 psig working pressures, Duo Equalizing Expansion Joints can be designed for higher pressures.

Service. The Duo Equalizing Expansion Joint is preferred for all outdoor piping systems subjected to atmospheric temperature changes—as well as for institutional and other services that operate on frequent on and off cycles.

Get the complete story of the new Zallea Duo Equalizing Expansion Joint in our newly published 72-page Zallea Expansion Joint Manual. Write today, on your Company letterhead, for your copy of Catalog 56. Zallea Brothers, 814 Locust Street, Wilmington 99, Delaware.

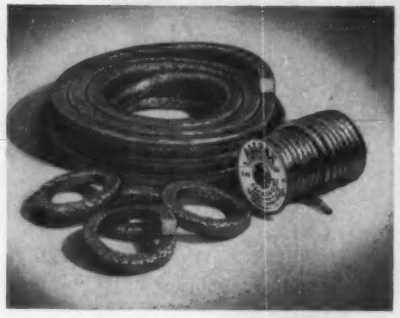


Zallea expansion joints

Zallea Brothers, Wilmington 99, Delaware • World's Largest manufacturers of expansion joints

I'm an all-around "PETROLEUM PACKER"

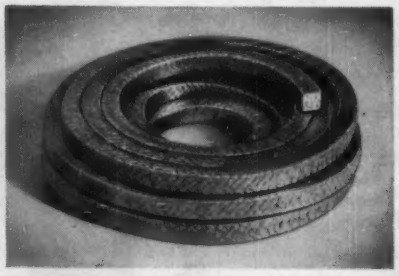
Petroleum service separates the men from the boys in the packing field—but you can count on Allpax Packings for this rugged service. They're the result of extensive laboratory research in the development of suitable packings for service against distillates and petroleum products. Recommended for use on centrifugal and rotary pumps, valve stems, swing joints and similar pumping equipment.



Style No. 14– For regular petroleum service. Excellent against gasoline, light and heavy oils, benzol, toluol, etc. For temperatures up to 550 degrees F. Compounded of long asbestos fibres, fine flakes of graphite, and a special bonding compound containing an oil-resistant lubricant.

Style No. 13– For extremes in high and low temperatures.

Style No. 30– For use against petroleum products at high temperatures and pressures. A very dense packing, made by braiding jackets of asbestos yarn over a center core of pure asbestos content. The jacket is treated with a special heat-resistant compound. The outer jacket is lubricated with a coating of graphite.



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A complete line of packing, tools, gasket materials
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REPORTS from the FIELD

Begins on page 156

tricity needed. No light bulb is used, a small glass disc gives off blue colored light.

Color cells, also exhibited, point the way to psychologically keyed lighting for the future.

Researchers declare that while the new light source is not yet up to today's light efficiencies, present rate of progress indicates that practical usage is "just over the next hill."

Calendar of Events

Nov 8-9—National Association of Corrosion Engineers, meeting of Southeast region. Charlotte, N. C. Details from NACE, 1061 M & M Bldg, Houston 2, Texas.

Nov 12-16—1st annual National Industrial Development Exposition, New York Coliseum. Details from NIDE, 356 W 58th St, New York 19, N. Y.

Nov 13-15—Investment Casting Institute, 4th annual meeting. Sheraton Cadillac Hotel, Detroit. Details from ICI, 27 E Monroe, Chicago 3, Ill.

Nov 26-30—Third International Automation Exposition. Trade Show Bldg, N. Y. C. Details from Richard Rimbach Assoc, Rm 359, 525 Lexington Ave, New York 17, N. Y.

Nov 26-30—American Society of Mechanical Engineers, 22nd National Exposition of Power and Mechanical Engineering. New York Coliseum. Details from ASME, 29 W 39th St, New York 18, N. Y.

Nov 27-30—American Chemical Society, 9th National Chemical Exposition. Cleveland Public Auditorium. Complete details available from NCE, 86 E Randolph St, Chicago 1, Ill.

Dec 5-7—American Institute of Mining, Metallurgical and Petroleum Engineers, 14th annual Electric Furnace Steel Conference. Morrison Hotel, Chicago. Details from AIME, 29 W 39th St, New York 18, N. Y.

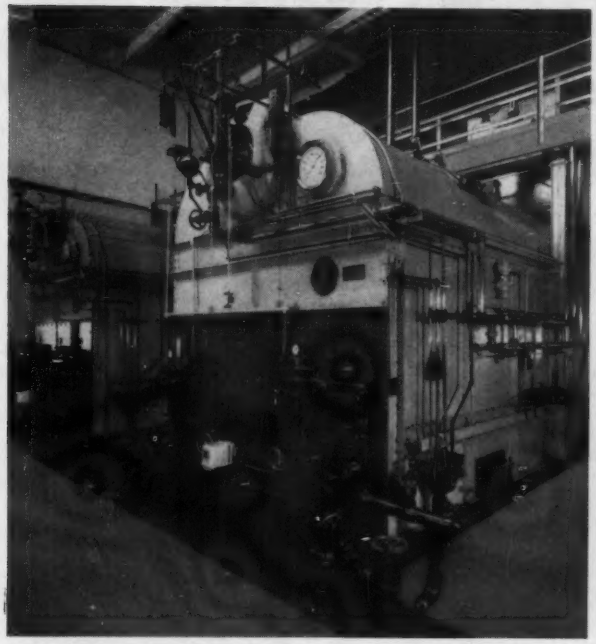
Jan 21-22—Association for Applied Solar Energy, 2-day symposium on solar furnace design and operation. Hotel Westward Ho, Phoenix. Details from AASE, 3424 N Central Ave, Phoenix.

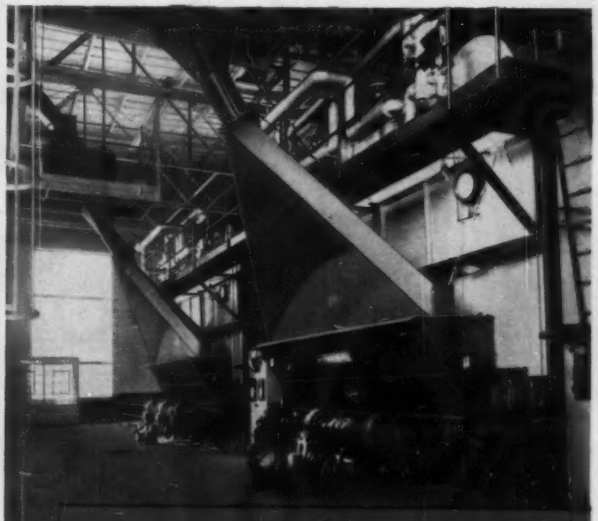
Jan 28-31—Plant Maintenance and Engineering Show. Public Auditorium, Cleveland. Details from Clapp & Poliak Inc, 341 Madison Ave, New York 17, N. Y.

Feb 25-March 1—American Society of Heating and Air Conditioning Engi-

KEELER "CP" ALL-PURPOSE BOILER

continues to deliver more steam capacity in a given space . . . larger combustion chamber with less head room than other types





Left above—Two oil fired Keeler "CP" boilers, each with 16,500-lb. steam capacity. Right above—Two Keeler "CP" boilers, each with 60,000-lb. steam capacity, operating with multiple retort bituminous coal stokers.

In thousands of operations throughout the nation and abroad, the Keeler "CP" continues to be the "pacesetter" in providing a reliable, efficient source of low cost steam for power, process and heat requirements—with user reports like these . . .

"fuel savings of approximately $700 per month" . . ."reduction of 25% over cost of operating previous boilers"..."operating almost continuously at 200% to 250% of rating and maintenance has been practically nothing"!

The Keeler "CP" is a fully steel encased and insulated water tube steam generator with water cooled walls. Among its many features, the "CP" water circulation occurs in a free and unrestricted flow, without the use of internal baffle plates. This permits operation at high overloads with exceptionally dry steam and no disturbance of the water level. The "CP" is readily convertible to all methods of firing, for all types of fuels—coal, oil, natural gas or waste gas.

Keeler boiler efficiency and dependability is available in a size unit required for your service . . . write or phone for complete information.

KEELER Type CP

READILY CONVERTIBLE

Original of its type, the "CP" delivers high efficiency with induced or natural draft operation—designed for all types of fuel and readily convertible at minimum cost. Made in a wide range of sizes in pressures to 500 psi and capacities to 150,000-lbs. of steam per hour. Shipped shop assembled up to and including 350 rated horsepower.

The Seal of Quality in Water Tube Boilers

— ESTABLISHED 1864 —

Write For Bulletins

No. F-14: Type CP Package Boilers
No. M-2A: Type CPM Package Boilers
No. DK-1: Type DK Package Boilers
No. MK-1: Type MK Boilers

KEELER WATER TUBE Boilers

E. KEELER CO.

200-300 West St. • WILLIAMSPORT, PA.

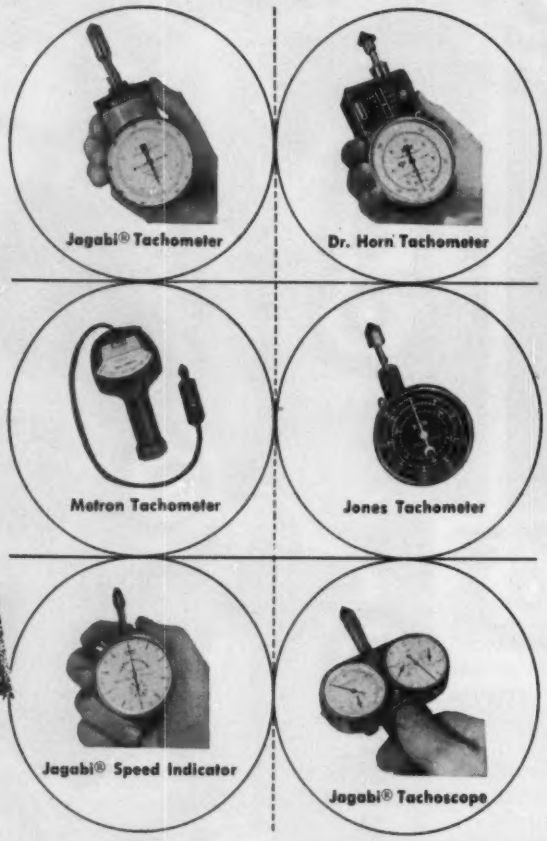
— OFFICES IN PRINCIPAL CITIES —

Frahm® Resonant Reed Tachometer

Operates simply by being held against or mounted on the machine under test. Measures vibrations per minute as well as rpm from 900 to as high as 100,000. Long life . . . no moving parts.

COMPLETE SELECTION OF

***Speed* MEASURING INSTRUMENTS**



The range of speed measuring instruments available at Biddle gives you a complete selection from resonant reed to centrifugal and chronometric types. Bulletin 35-P includes a Handy Selection Chart, and descriptions of all the tachometers in the Biddle line. Whether you want readings of instantaneous speeds, variations in speeds, or average measuring in RPM or FPM, let us recommend the proper instrument for you. "It's easy to be sure—Just be sure it's from Biddle."

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• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

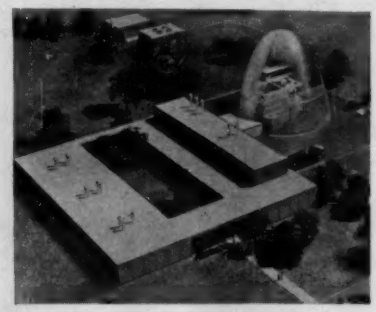
1316 ARCH STREET
PHILADELPHIA 7, PA.

REPORTS from the FIELD

Begins on page 156

neers, 13th International Heating and Air Conditioning Exposition. International Amphitheatre, Chicago. Details from International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

March 25-29—American Society for Metals, 10th Western Metal Congress and Exposition. Pan-Pacific Auditorium, Los Angeles. Details from ASM, 7303 Euclid Ave, Cleveland, Ohio.



Ten corporations form company for atomic energy research

► TEN CORPORATIONS have formed a new company, Industrial Reactor Laboratories, Inc, to build and operate a privately owned nuclear reactor for industrial research in atomic energy, at Plainsboro, N. J.

Each participant is represented on the board of directors, which will be headed by General Walter Bedell Smith, President, and H L Hilyard, Vice President.

Companies participating are Atlas Powder Co, AMF Atomics Inc, American Tobacco Co, Continental Can Co, Corning Glass Works, National Distillers Products Corp, National Lead Co, Radio Corp of America, Socony Mobil Oil Co, and United States Rubber Co.

Russian solar power station planned for Armenia

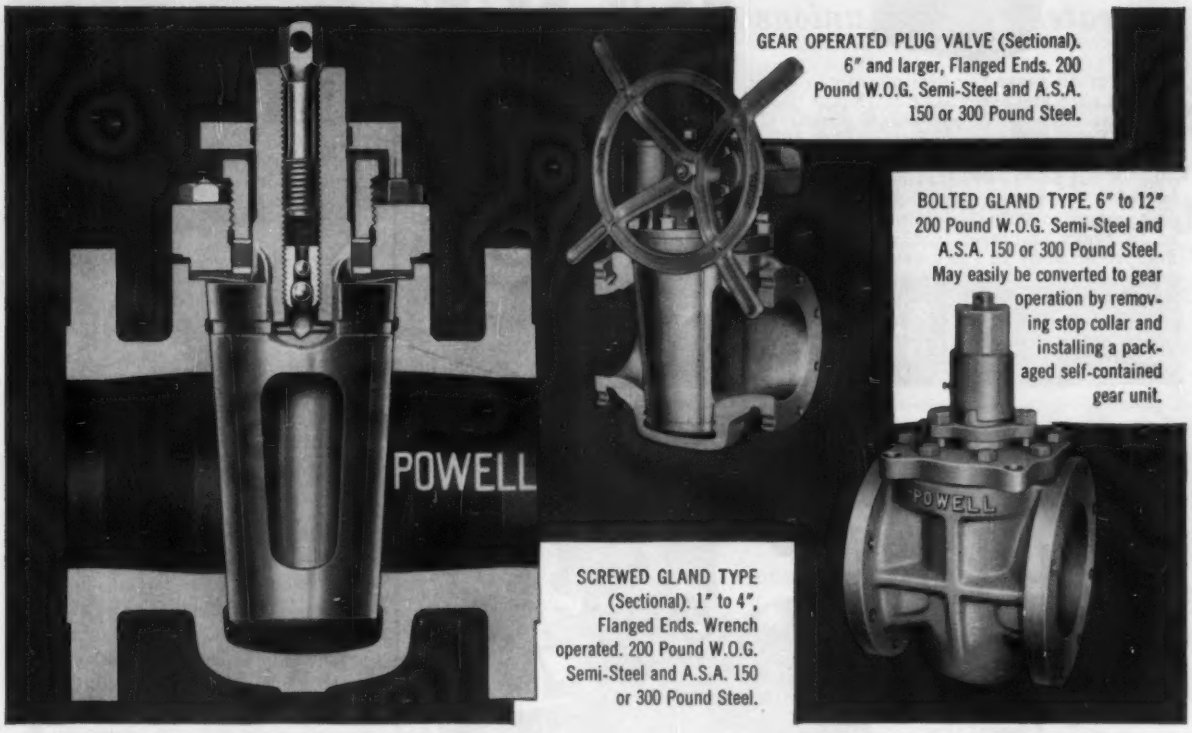
► RUSSIA IS CLAIMING the first "solar" power station, according to informed sources. Station, to be located in Armenia S.S.R., is said to be in the blueprint stage in Russia.

Armenia has been chosen for this project because it has 2600 sunny hours per annum, the highest rate of sunshine in the USSR. Plant is not a test station but will serve an industrial purpose. It is planned that in the future smaller solar plants will be set up to operate pumps for irrigation of swamp area of the Ararat Plains. Used steam is to be further utilized to heat homes

POWELL

Lubricated Plug

VALVES



GEAR OPERATED PLUG VALVE (Sectional). 6" and larger, Flanged Ends. 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel.

BOLTED GLAND TYPE. 6" to 12" 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel. May easily be converted to gear operation by removing stop collar and installing a packaged self-contained gear unit.

SCREWED GLAND TYPE (Sectional). 1" to 4", Flanged Ends. Wrench operated. 200 Pound W.O.G. Semi-Steel and A.S.A. 150 or 300 Pound Steel.

Powell Lubricated Plug Valves maintain our 110-year tradition of quality and precision. Only the finest available materials are used. And painstaking quality control is rigidly enforced through each and every step of manufacture.

Features include quick and positive operation—just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

Valve users who want one source of supply for lubricated plug as well as all types of bronze, iron, steel and corrosion-resistant valves will want full details on Powell Lubricated Plug Valves.

Available in Steel and Semi-Steel through distributors in principal cities. If none is located near you—or if you need help on valve problems—write direct to

PERFORMANCE
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BRONZE, IRON, STEEL AND CORROSION-RESISTANT VALVES

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

The source of supply for all valve needs!

GUARANTEED

to give drip-tight leak-proof seal

Available through your local distributor

greates[illegible] in unions **DART**

For over 55 years the firm guarantee back of each and every DART UNION sold has been — *"if one should leak through we will give you two"!* The record reveals that less than 1 in every 100,000 has proven to be faulty. The extra wide bronze to bronze seats, precision ground to a true ball joint, mounted in heavy malleable iron pipe ends and protected by an extra heavy union nut, make a drip-tight, leak-proof connection WITHOUT EXCESSIVE WRENCHING time and time again.

Guarantee positive tight connections and extra long service on your pipe lines by using the DART GUARANTEED UNION.

Yours on request: Descriptive brochure on Dart Unions and Union Fittings.

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HIGH Flow rate LOW OPERATION COST

WITH VIKING PUMPS

Sparkler Manufacturing Company, Mundelein, Illinois, assures high quality performance, high flow rate, and low operation cost by including Viking pumps as original equipment on their horizontal plate filters for clarifying resinous coatings.

Filters range in capacity from 300, 500, 700, 1000, 1700, 2000 and 3000 gallons per hour, and Viking pumps are available in the sizes required to meet all of these capacities.

Vikings are adaptable to many pumping requirements—perhaps yours, too. For information, write for Bulletin 565w.

VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's ***"ROTO-KING"*** pumps

THE ORIGINAL *"GEAR-WITHIN-A-GEAR"* ROTARY PUMP

See our catalog in Sweets

REPORTS from the FIELD

Begins on page 156

and economic units in the near neighborhood. A special underground heating vault for water of 70 to 80 C is claimed to be a novelty, working on the thermos bottle principle.

Basic plans have been drawn up by the "Krzhizhanovski" Energetics Institute of the Academy of Science of the USSR. Chief supervisory body during construction and operation is the Armenian S.S.R.'s Academy of Sciences.

GE develops ultrasonic simulator for rotor inspection

► AN ULTRASONIC ROTOR inspection simulator, shown above, for training ultrasonic inspectors of large turbine and generator rotor forgings has been developed by General Electric engineers.

Simulator is said to graphically demonstrate qualitative and quantitative effects of an internal defect in a rotor as well as its size and shape.

Device can use either of two piezoelectric transducer crystals—one of 1 megacycle and another of 2¼ megacycles.

Nov 26 Power Show to reveal new fields of industry

► NEW FIELDS OF INDUSTRY will be uncovered at the 22nd National Exposition of Power and Mechanical Engineering, which will kick off November 26 at the New York Coliseum.

The four-day show will be a complete exposition. It will begin with the fuel source of power and carry through with displays portraying the entire sequence of fuel conversion into heat and power—to the motor that operates the machine tool, the operating and regulating mechanisms of chemical con-

PERMANENT WATER BARRIER

for hot underground pipes

Anyone can install Tri-sul-ite. It is supplied in 100 lb. black and silver bags and merely poured around the pipes in the ditch, tamped and cured.

TRI-SUL-ITE

3-WAY PROTECTION SYSTEM

(formerly INSUL-ITE)

- Water cannot follow the grade of the pipe
- Prevents corrosion
- Excellent insulating value
- Very low material and installation costs
- Speediest, simplest installation
- Eliminates maintenance
- Easily adaptable to future pipe changes

WHAT DOES TRI-SUL-ITE DO?

Tri-sul-ite is a specially selected and granulated gilsonite. After being poured and tamped around the pipes, it forms, by proper curing, 3 *permanent* zones for protecting against water, corrosion and underground heat loss. The first zone adjacent to the pipe fuses, from pipe heat, into an impermeable, water- and corrosion-proof coating. The second zone of partially fused material has excellent insulating properties. The third zone of unfused Tri-sul-ite granules provides maximum insulating efficiency plus unusually high resistance to water penetration.

Tri-sul-ite comes in three types:

Type 1 for pipe temperature range between 220°F. and 300°F.

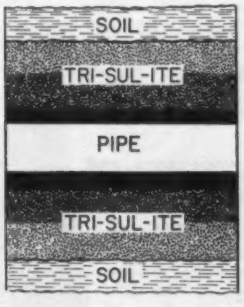
Type 2 for temperature range between 300°F. and 385°F.

Type 3 for temperature range between 385°F. and 520°F.

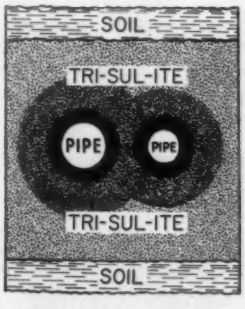
OTHER SPECIAL ADVANTAGES

- No extra housing required. Tri-sul-ite forms its own protective covering.
- Only normal pipe spacing is needed. Ells, loops and multiple pipe lines present no difficulty whatsoever.
- When you use Tri-sul-ite you obtain expert field service and installation guidance by qualified engineers.

SIDE VIEW



FRONT VIEW



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GUARANTEED

to give drip-tight leak-proof seal

Available through your local distributor

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For over 55 years the firm guarantee back of each and every DART UNION sold has been — *"if one should leak through we will give you two"!* The record reveals that less than 1 in every 100,000 has proven to be faulty. The extra wide bronze to bronze seats, precision ground to a true ball joint, mounted in heavy malleable iron pipe ends and protected by an extra heavy union nut, make a drip-tight, leak-proof connection WITHOUT EXCESSIVE WRENCHING time and time again.

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HIGH Flow rate LOW OPERATION COST

WITH VIKING PUMPS

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for hot underground pipes

Anyone can install Tri-sul-ite. It is supplied in 100 lb. black and silver bags and merely poured around the pipes in the ditch, tamped and cured.

TRI-SUL-ITE

3-WAY PROTECTION SYSTEM

(formerly INSUL-ITE)

- Water cannot follow the grade of the pipe
- Prevents corrosion
- Excellent insulating value
- Very low material and installation costs
- Speediest, simplest installation
- Eliminates maintenance
- Easily adaptable to future pipe changes

WHAT DOES TRI-SUL-ITE DO?

Tri-sul-ite is a specially selected and granulated gilsonite. After being poured and tamped around the pipes, it forms, by proper curing, 3 *permanent* zones for protecting against water, corrosion and underground heat loss. The first zone adjacent to the pipe fuses, from pipe heat, into an impermeable, water- and corrosion-proof coating. The second zone of partially fused material has excellent insulating properties. The third zone of unfused Tri-sul-ite granules provides maximum insulating efficiency plus unusually high resistance to water penetration.

Tri-sul-ite comes in three types:

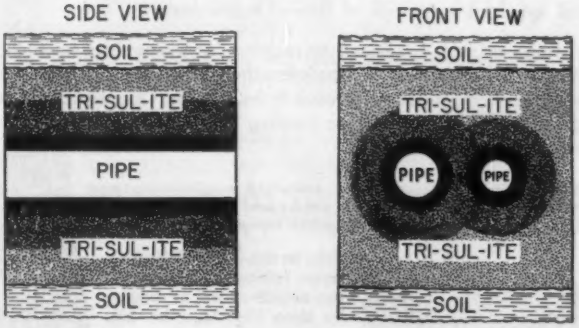
Type 1 for pipe temperature range between 220°F. and 300°F.

Type 2 for temperature range between 300°F. and 385°F.

Type 3 for temperature range between 385°F. and 520°F.

OTHER SPECIAL ADVANTAGES

- No extra housing required. Tri-sul-ite forms its own protective covering.
- Only normal pipe spacing is needed. Ells, loops and multiple pipe lines present no difficulty whatsoever.
- When you use Tri-sul-ite you obtain expert field service and installation guidance by qualified engineers.



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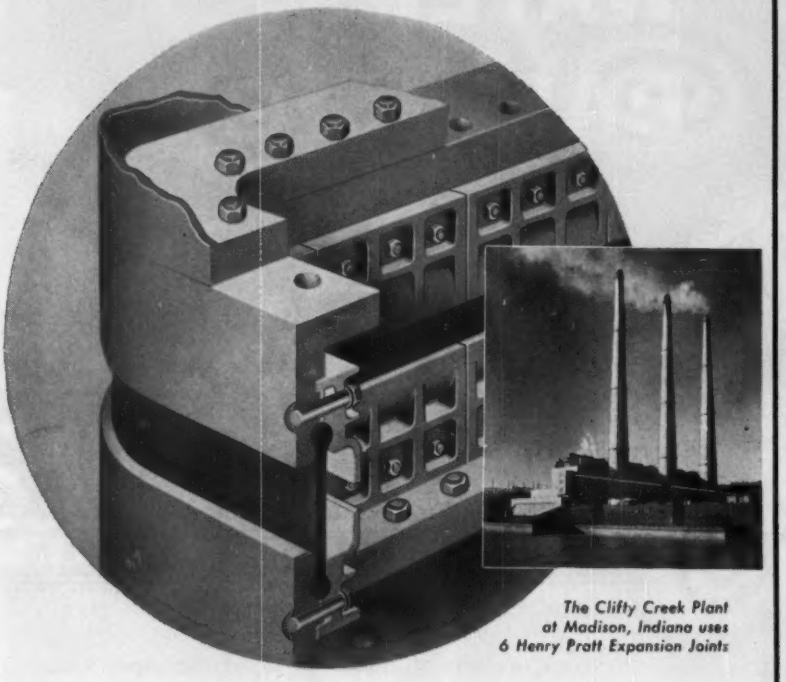


The Clifty Creek Plant at Madison, Indiana uses 6 Henry Pratt Expansion Joints

This expansion joint insures Turbine-Condenser alignment

The size and complexity of modern power plants have made it very difficult to foresee all the problems involved in mounting condensers and turbines. Often the final piping engineering is not completed until after the units are installed. By using a rubber belt expansion joint between the turbine and condenser, both the engineering and the construction are greatly simplified. Construction tolerance can be held to reasonably obtainable values because the expansion joint will absorb up to one inch of axial and one-half inch of lateral movement.

Any shape or size . . . Round or rectangular shapes can be built without size limitation . . . if one dimension is less than 14'9" the joint can be shipped fully assembled, a great convenience to installation. Connections for welding, bolting or combinations such as landing bar and weld can be supplied as needed.

The Henry Pratt Company offers complete engineering and manufacturing facilities for exhaust stacks and joints, flues, ducts, butterfly valves and other power plant equipment.

Write for this detailed folder, discusses Turbine-Condenser connection methods as well as detailing the Henry Pratt Expansion Joint
Ask for Bulletin—5K

HENRY
PRATT

TURBINE-CONDENSER
Expansion Joints

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill.

verters, the digester in the food manufacturing plant, and many other applications through to materials handling for outgoing manufacturers' products.

Exhibits will include in detail innovations in equipment for converting energy from coal and oil—and now from the atom of rare metal—into heat and power. They will include means for distribution of heat and power, and for their adaptation and control.

Model generating stations will reveal the latest conceptions in designs for the complete plant. Operative displays in scale models, or in working models with transparent housings, will demonstrate individual stages in processing, or reveal the behavior of materials under actual working conditions. The cumulative effect, according to spokesmen for the show, will add up to a tightly packed refresher course for many visiting engineers.

McGraw-Hill to publish ten-volume encyclopedia on science

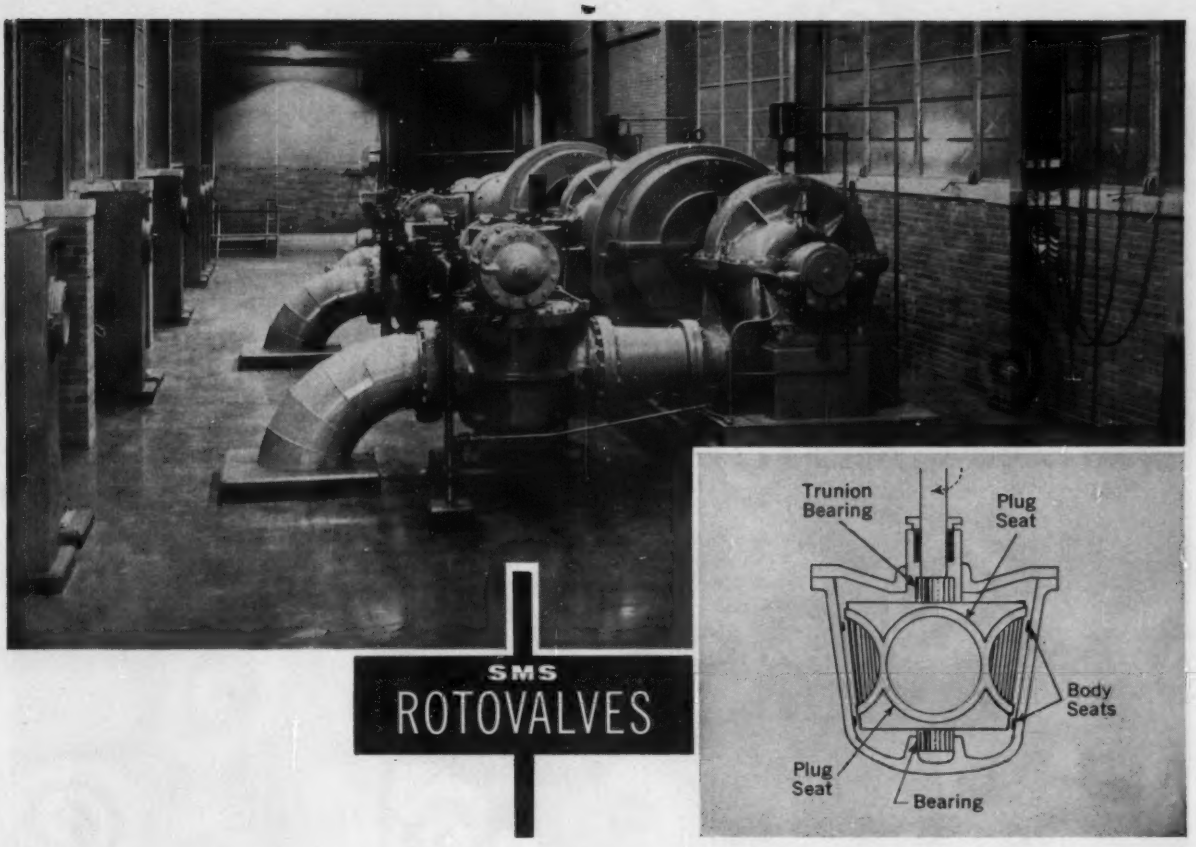
► McGraw-Hill Book Co will publish a multi-volume compendium of today's scientific and technical knowledge called the *McGraw-Hill Encyclopedia of Science and Technology*, according to Curtis G Benjamin, president of the company.

Encyclopedia will be made up of several thousand alphabetically arranged and cross indexed articles, written by acknowledged authorities in science and engineering. Readability and comprehension, in general, will be at the college underclassman level. Designed to serve as a complete reference work for student, teacher, engineer, scientist and others seeking information on scientific and engineering subjects, it will total some 7000 oversize pages, probably bound in ten volumes, and will be well illustrated. It will be completed in about three years.

Power engineers' annual meeting held in Winnipeg this year

► This year, for the first time, the Institute of Power Engineers held its annual convention in Western Canada. At the Winnipeg meeting, Charles E Baker was elected president for a seventh term. First vice-president is George E Gibson, second vice-president, William J Longeway. George W Smith was elected general secretary.

A feature of the meeting was the presentation to William J Longeway of the Institute's highest award, for his



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Performance characteristics like these are the result of more than 75 years of hydraulic research and engineering. To get full information on the complete line of Rotovalves, Ball Valves and Butterfly Valves, contact our local representative or write S. Morgan Smith Co., York, Pa.

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AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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"Just one more question, Herb."

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"Do we have to stand outside here and freeze?"

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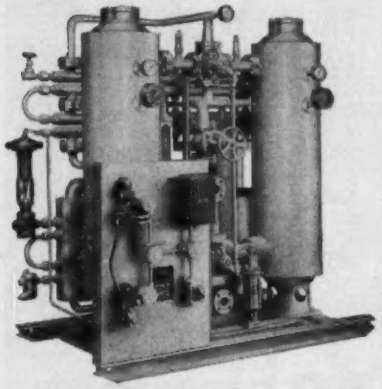

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REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

REPORTS from the FIELD

Begins on page 156

many contributions to the growth and development of IPE.

Chairmen of national committees for the coming year are: William W McNeill, *Finance;* William J Longeway, *Public Relations;* Frank Sharp, *Registration, Examining and Standardization;* T C Bishop, *Education;* George E Gibson, James Black, *Membership;* J C Ward, *Employment.*

Institute Service Award citations and crests were presented to: Charles E Baker, Thomas C Bishop, Foster A R McLeod, George E Gibson, Sam Boyle, Fred Bignell, William J Longeway, John C Ward, George W Smith, Frank Sharp, Harvey R Burt, Geoffrey A Andrews, Robert I Scott, Sidney Robson, Charles T Johnson, E A Campbell, Joseph L Jolie, Henry H Wright, James Y Smith, M N Joubert, David Blakely, John Hastie, Gordon Clarabut, George Draayer. Service award citations went to James Dunn and L J Stuart.

In addition, Service Award "honorable mention" citations were presented to: W H Hildreth, James Black, George Gould, W B Mayhew, George E Stuhr, Charles E Scott, Henry P Courtney, Noel Moffitt, Michael Miller, Arthur J R Rees, Paul Gervais, Frank Walker, James Barr, William G Jackson, James Caldwell, Frank Hinchcliffe, Fred Mills, Louis Devos, Frank Robin, W J Welsh.

Next year, IPE will meet at Toronto. A power show will be held in conjunction with the convention.

Kyushu Electric Power Co has signed a contract with Westinghouse Electric International for purchase of $10,860,000 worth of Westinghouse thermal power generating facilities with an output of 156,250 kw. Facilities will be imported from September 1957 to March 1958. Power production is scheduled to begin November 1958.

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

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With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

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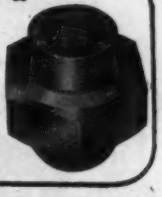
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



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APPOINTMENTS

Corporation executive changes

Minneapolis - Honeywell Regulator Co: W W Gilmore, vice-president. **Square D Co:** Wilbur H Peter Jr, vice-president. **Texas Eastern Transmission Corp:** George T Naff, vice-chairman of board; Orville S Carpenter, president. **Shaleo Engineering Corp:** Herbert von Wolff, vice-president and general sales manager.

General Electric Co: Carter L Redd, commercial vice-president, Southeastern district. **Dresser Industries Inc:** Ott Hammer, vice-president; Carra L Lane, president of Security Engineering division. **Cook Electric Co:** William H Miller, vice-president, manufacturing. **The Ramo - Woldridge Corp:** V G Nielson and Gordon P Saville, vice-presidents. **Harlan Electric Co:** Fred A Compton, vice-president.

Operations executive changes

The Electric Storage Battery Co: William J Ashford Jr, manager of missile applications division. **Sylvania Electric Products Inc:** Henry F Callahan, general manager of lighting division. **Westinghouse Electric Co:** heat-transfer apparatus dept—P L Fetzer, sales manager; M A Nelson, engineering manager; W E Rudloff, manufacturing manager; steam division—L M Eikner, manager of large turbines; R C Twombly, manager of small turbines.

Dravo Corp: D R Berg, project manager for nuclear power plant contract, Shippingport, Pa. **Ford Instrument Co:** Pio Franco Martinuzzi, technical consultant to vice-president for engineering. **Thomas A Edison Inc:** John E Sloane, manager of general services. **The Youngstown Sheet and Tube Co:** Ralph C Wolf, assistant superintendent, Blooming and Skelp Mills, Campbell plant.

Sales, district managers

Babcock & Wilcox Co, Tubular Products division: Millard A Hammond, manager of welding fittings sales. **Allis-Chalmers Manufacturing Co:** R H Cline, Pittsburgh district; C B Rumble Jr, Charlotte district. **Detroit Edison Co:** Howard R Stevenson, manager of sales; George L Lahodny, assistant manager of sales. **Iron Fireman Manufacturing Co:** Howard M Cutshaw, general sales manager; Gurth Baldwin, St Louis district manager; Richard H Byers, Cleveland branch manager.

Westinghouse Electric Corp: Lyman L Clark, sales manager of Sunnyvale plant; Harry H Humphry, transformer sales manager. **Consolidated Diesel Electric Corp:** Jens F Louv Jr,

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Fig. 10 Plain Sight Illuminator
Fig. 31 Guard
Fig. 15 DCP weighted try cock
Fig. 5 Standard vertical bronze water gage, 350 pound

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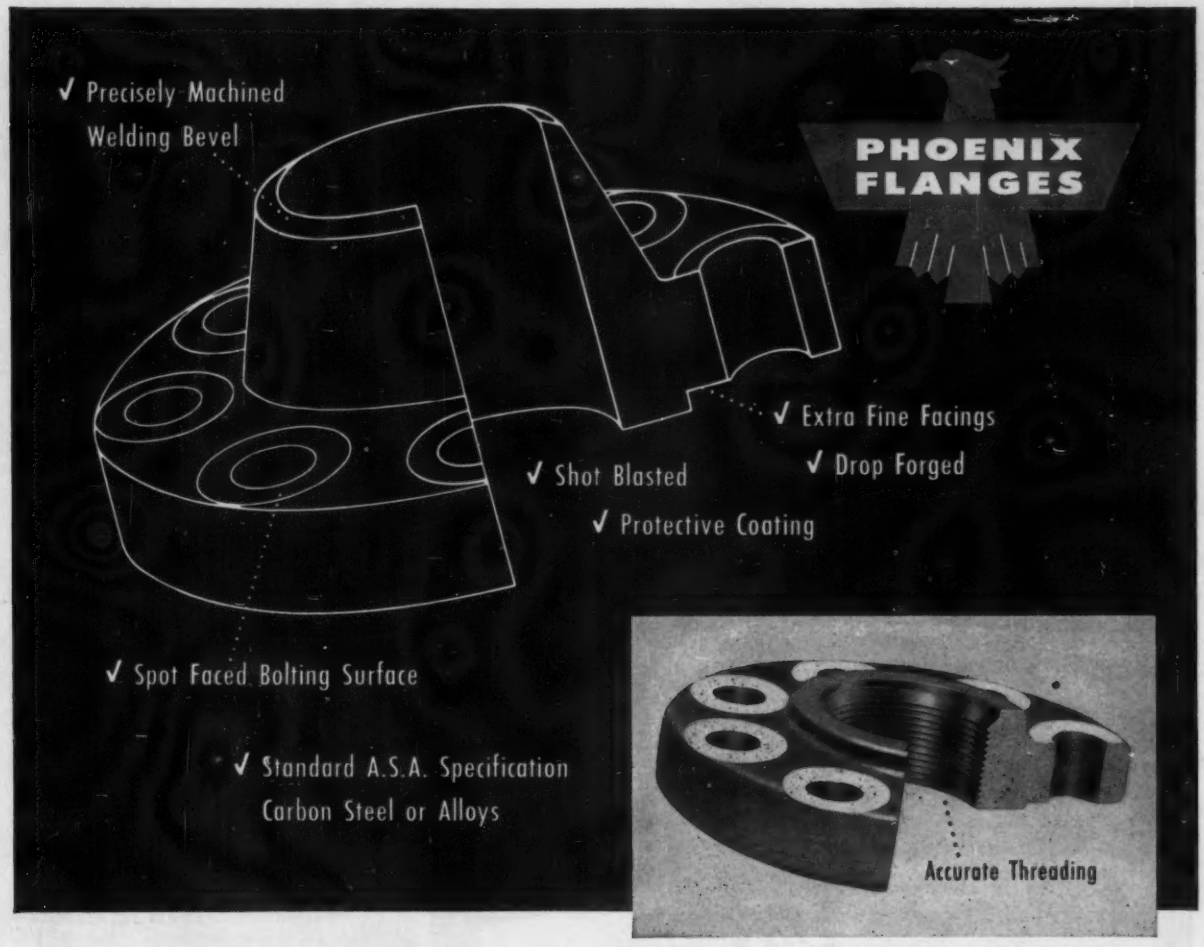

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We needn't tell you what kind of life and service you demand from the pipe flanges you buy. The important thing to know is that you are ordering flanges which will be consistently high in quality. Phoenix drop-forged flanges *always* meet the highest quality and strength specifications. No one makes a better flange!

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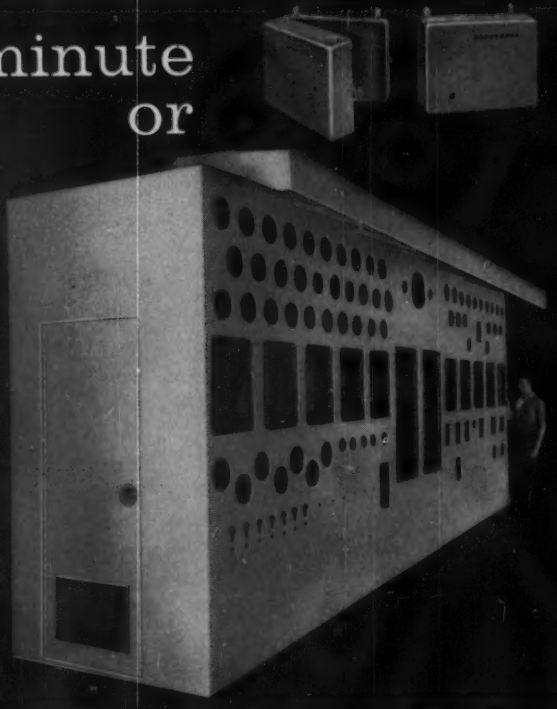

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Control Panels • Transformer Tanks
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KIRK & BLUM
METAL FABRICATION

More APPOINTMENTS

Begins on page 246

sales manager for Consolidated Diesel Electric Corp of Canada, a subsidiary.

New sales offices

Pacific Pumps, Inc: at 4500 Euclid Ave, Cleveland 15, Ohio. **Griscom-Russell-Schack Co:** at 901 Ridge Ave Pittsburgh 12, Pa. **Universal Wire & Cable Co:** warehouse and sales office at 5107 Telegraph Rd, Los Angeles, Calif. **Sequoia Process Corp:** office and warehouse at 17 William St, Newark, N. J. **Ross Heat Exchanger div** of American Standard: at 522 N McDonough St, Decatur, Ga. **Jas P Marsh Corp:** 27 Temple St, Quincy, Mass.

Morse Chain Co: sales office and warehouse at 405 W Griffith St, Charlotte, N. C. **De Laval Steam Turbine Co:** at 1610 5th Ave, Moline, Ill., H A Besocke, manager. **Electronics Corporation of America,** Combustion Control Division: at 550 Grant St, Pittsburgh, Pa. Walter L Brink, manager.

New representatives

For **Cleaver-Brooks Co:** Miller & Chitty Co, 1367 Stuyvesant Ave, Union, N. J. and Jim Marshall Sales Engineering Service, 135 W Hollywood, San Antonio, Texas. For **Walsh Refractories Corp:** William Hegmann Jr, Arkansas and Oklahoma territories. For **J F Pritchard and Co of California:** R J Clark Equipment Co, Inc, Clearwater, Fla. For **Hills-McCanna Co,** Warren D Ehrke & Co, 1844 W Atkinson Ave, Milwaukee 6, Wis.

Engineer changes

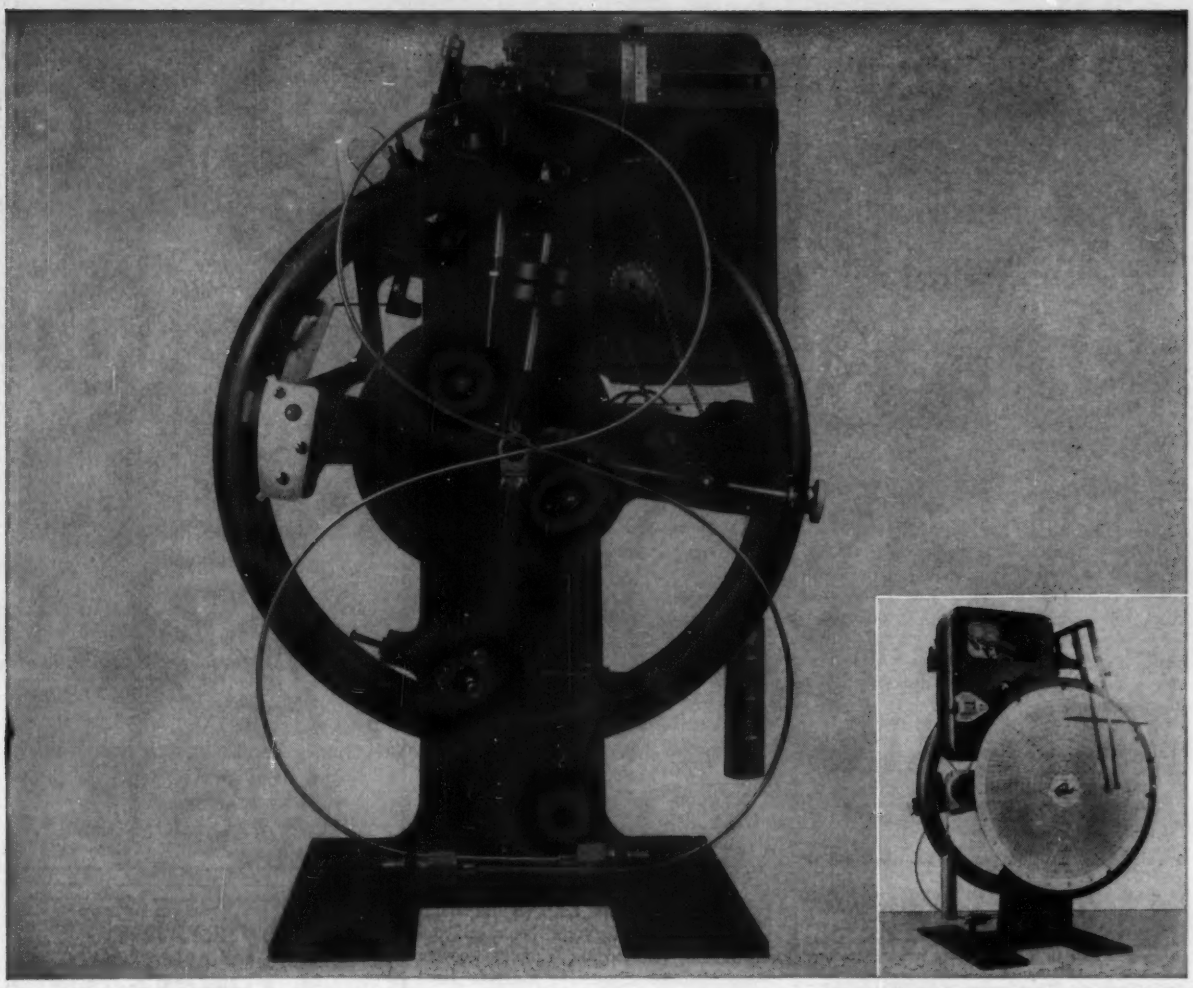
Allis-Chalmers Manufacturing Co: C B Graham, chief engineer, nuclear power dept. **Westinghouse Electric Corp:** C C Franck, consulting engineer, steam division. **The Martin Co:** Samuel Storcheim, chief of manufacturing engineering and research in nuclear division. **Dravo Corp:** William C Stratton, chief engineer, engineering and construction dept. **General Electric Co:** Costas Sfikas, turbine specialist, International division. **Valvair Corp:** Richard R Kesti, chief engineer. **Libbey-Owens-Ford Glass Co:** Donald J Vild, technical service engineer.

Obituaries

John Thomas, former vice-president, engineering of Alco Products, Inc, on August 31st.

Donald L McClure, 49, recently-appointed general manager of the Corrulux Division, LOF Glass Fibers Co, on September 14th.

Joseph A Birkhead, 58, southwestern sales representative of the Lunkenheimer Co, on September 2nd.



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Simple, direct action and sturdy construction assure dependable, trouble-free service in Hagan Ring Balance Meters. The famous Ring Balance principle produces high accuracy, even at low differentials and at low rates of flow.

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BOOKSHELF

Hydraulic Research in the United States. *National Bureau of Standards Miscellaneous Publication 218. By Helen Middleton. 216 pp. $1.50. Government Printing Office, Washington 25, D. C.*

The information contained in this publication was compiled from reports by various hydraulic and hydrologic laboratories in the United States and Canada. The projects are listed chronologically with the assigned numbers repeated for identification purposes until a project is completed. Projects numbered from 2255 on are reported for the first time and all projects are in an active state unless otherwise noted.

File reports and other detailed information are not included in the volume but may be obtained from the correspondent listed under or immediately following the title of the organization reporting.

Linear Transient Analysis. *Vol II By Dr Ernst Weber, head of the electrical engineering department and Director of the Microwave Research Institute, Polytechnic Institute of Brooklyn. 452 pp. $10.50. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N.Y.*

This book examines transient phenomena in passive and active two-terminal-pair networks, filters and transmission lines. The first chapter provides a brief review of the Fourier and LaPlace transform methods, making the new book self-contained. The succeeding chapters cover: passive fourpoles; passive fourpole lines (wave filters); idealized network characteristics (system theory); active fourpoles; lossless and distortionless transmission lines. A considerable portion of this material, as well as the author's approach to it, is available here for the first time in book form.

A mathematical treatment, this volume nevertheless stresses the physical background and the physical interpretation of a system, and shows in detail the applications to many practical problems encountered by engineers.

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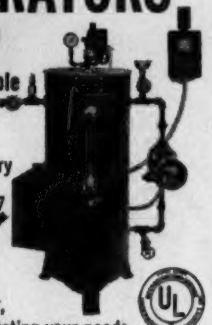

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Insure Insulation Efficiency with Childers Jacketing

Leading engineers world-wide specify Childers Jacketing for protecting costly insulation on lines, towers, vessels and tanks. These efficiency minded engineers prefer Childers Jacketing because of these exclusive features:

1. LAP-SEAL (patents pending) insures a more positive weather-seal.
2. Heavy weight jacketing designed for lines subject to abuse.
3. Deep Corrugated Jacketing with factory-attached moisture barrier for towers, vessels and tanks.
4. New resin adhesive that makes a stronger bond between the jacketing and the vapor barrier.

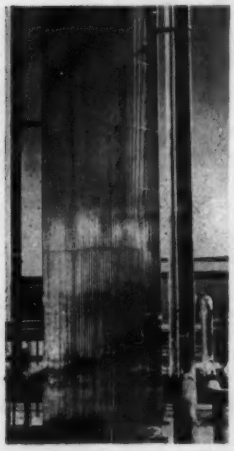
Childers Aluminum Jacketing provides strong, durable protection with three way savings:

1. Lower first cost than any other permanent jacketing.
2. Lower application cost because it's so easy to cut-to-size and attach.
3. Eliminates maintenance because it is made of durable aluminum for maximum corrosion resistance and requires no painting.

Economy minded engineers know that plant efficiency is improved when costly insulation is protected with Childers Aluminum Jacketing. And too, the gleaming beauty of Childers Jacketing makes plants brighter, neater — reduces "housekeeping" costs.

Send for Free Sample and Prices

You can help increase the efficiency of your insulated lines, towers, vessels and tanks by using Childers Jacketing. Write today for free sample and engineering data. Childers Manufacturing Co., Dept. P-10, Houston 8, Texas.

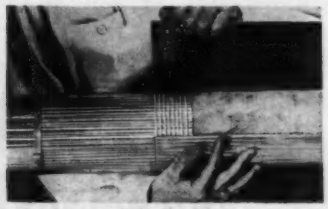


New Deep Corrugated Jacketing For Towers, Vessels and Tanks

Only Childers offers deep corrugated aluminum jacketing with factory-attached moisture barrier. Available in 1¼" and 2½" corrugations. Childers Deep Corrugated Jacketing is used to provide permanent protection for insulated towers, vessels and tanks.

Heavy Weight Jacketing

Only Childers offers .019" Jacketing in labor saving 4' wide rolls. This exclusive product is recommended to protect insulated lines along walkways and in other areas where they are subject to abuse; also recommended for protection of all insulated towers, vessels and tanks.



Lap-Seal

Childers exclusive LAP-SEAL is a series of eight ribs rolled into the underlapping edge of the jacketing.

Lap-Seal has 2 important advantages:

1. Where desired, a positive weather seal is easily made with Lap-Seal and a mastic.
2. Lap-Seal provides an automatic measure of the 2" circumferential lap. It saves labor, insures proper lap and prevents waste.

use steam efficiently, economically—choose the trap with . . .

top quality...

to keep it on the job

No need for a steam trap to be complicated. All it does is discharge condensate and air from steam lines and equipment. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

A steam trap has to be built to serve long and dependably in severe service—and that's where Nicholson quality counts heavily in terms of performance.

- **One moving part**
- **Positive shutoff—no steam waste**
- **Powerful, intermittent valve action**
- **High capacity—effective use of large orifice**

Specify Nicholson, and be sure.

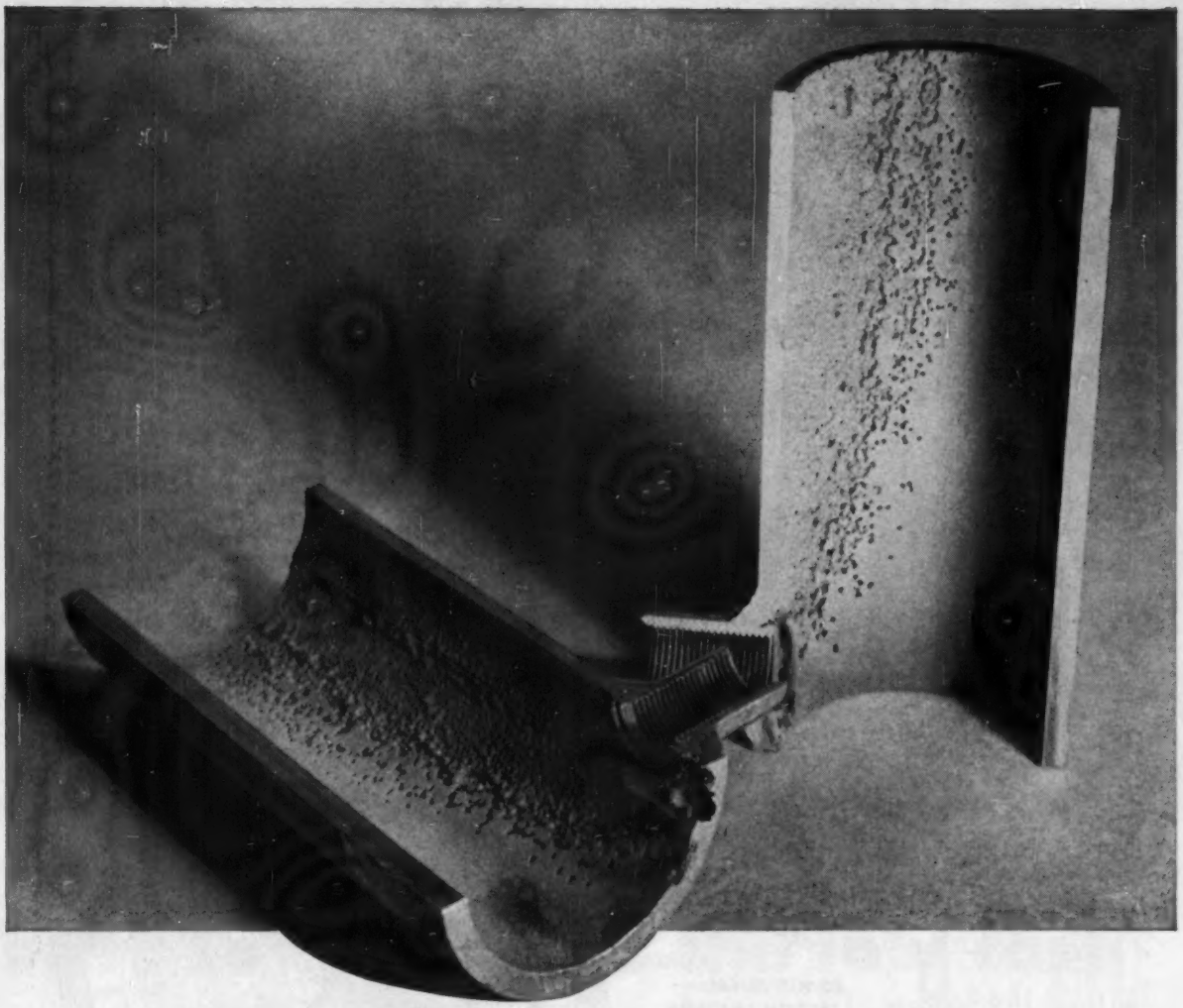
Write for new
Bulletin 10-55

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES



PIT-POCKED PICKPOCKET

In power-demanding industries, pitted pipe means out-of-pocket expense. The annual losses in labor and materials to replace equipment damaged by cavitation and corrosion reach staggering proportions.

The corrosive attack against this pipe was accelerated by mechanical action. Cold water injected into a high-pressure condensate return line caused steam collapse, resulting in violent hammering and cavitation-erosion damage. Because shock forces disrupted protective films on the interior surface of the pipe, failure occurred rapidly in this short section.

Dearborn Engineers spotted the cavitation problem, and recommended design changes which eliminated the trouble. Thereafter the entire return line system was fully protected by Filmeen.*

Dearborn Filmeen, a concentrated amine treatment, forms a continuous corrosion-inhibiting barrier between condensate and metal. This non-wettable film protects against both carbonic acid and oxygen corrosion. Filmeen readily disperses in hot condensate, permitting continuous feed direct to boiler or steam system.

Take advantage of Dearborn's Water Treatment and Engineering "know-how." Your Dearborn Representative will demonstrate Filmeen's efficiency in combatting destructive corrosion. He will survey your system and recommend control measures and feeding arrangements best suited to your plant requirements. The coupon will bring full details.

**FILMEEN—U.S. Pat. No. RE-23614 reserves to Dearborn Chemical Company and its licensees exclusive right to the use of octadecylamine for water treatment.*

Dearborn®

combatting corrosion wherever it occurs

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO
Chicago 54, Ill.

☐ Have a representative call.

☐ Send me more information on Dearborn Filmeen Water Treatment Service.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

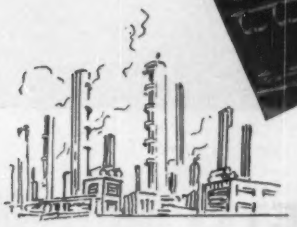
THIS 400,000 Pounds per HOUR

Vogt

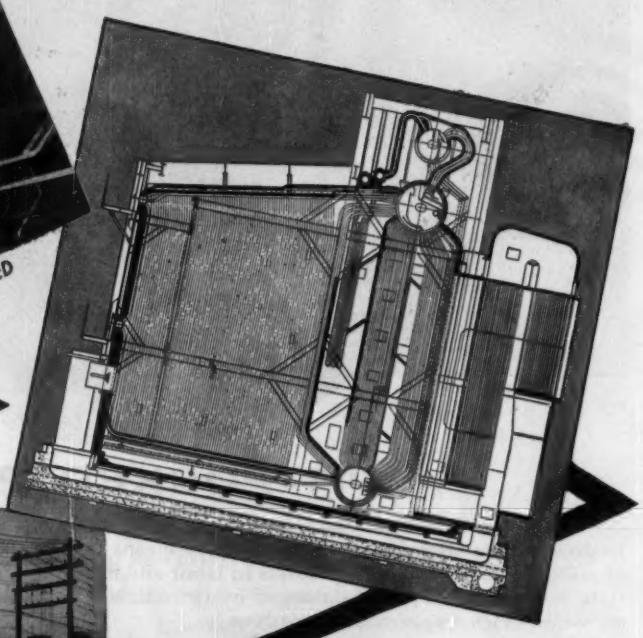
STEAM GENERATOR

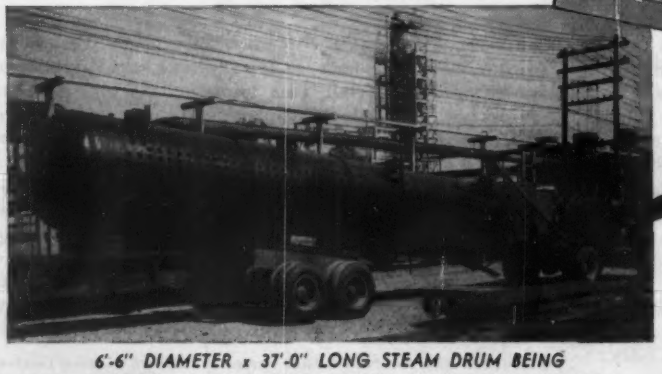
Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT →
LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

PRINCIPAL DATA

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

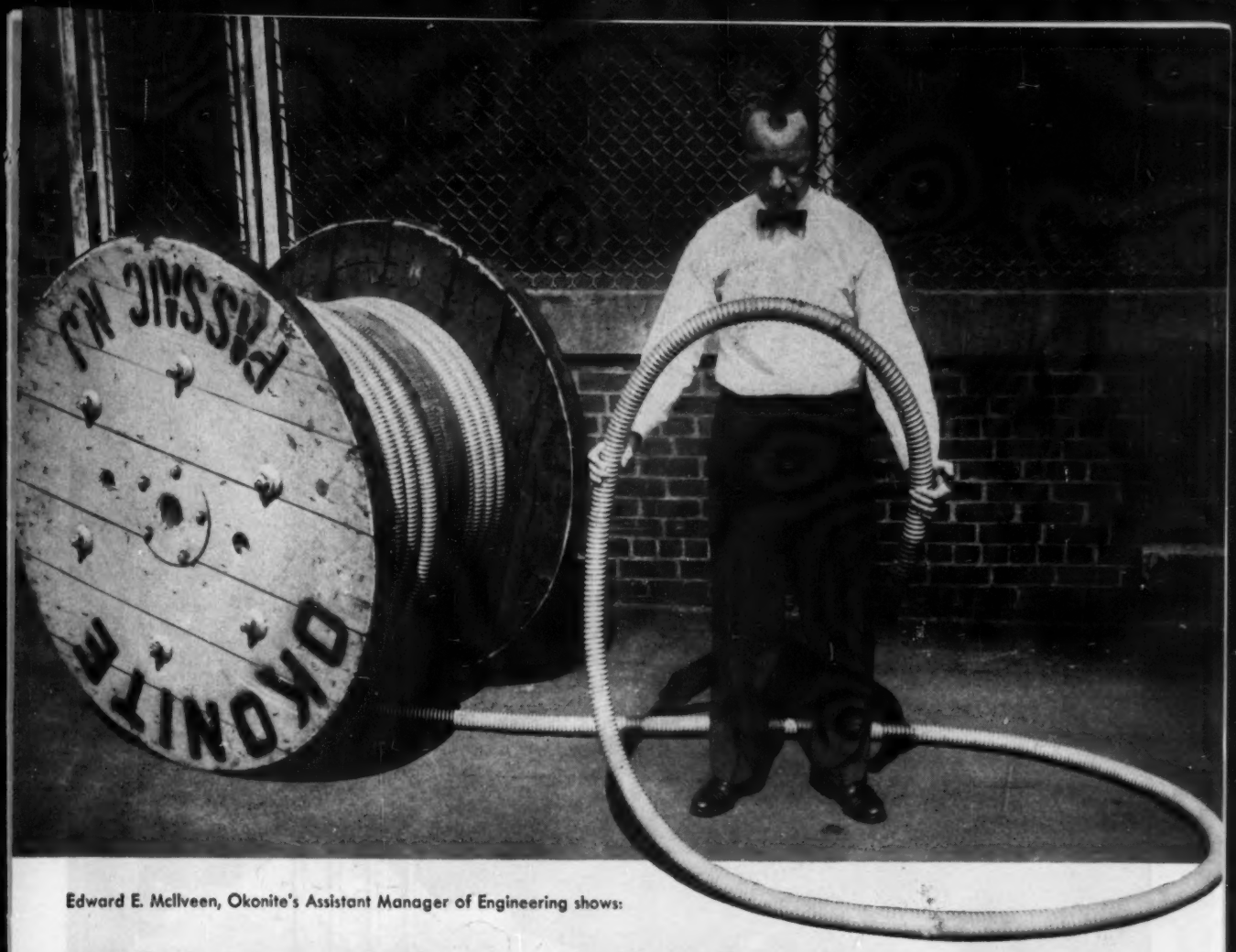
Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

Address Dept. 24A-BP

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.



Edward E. McIlveen, Okonite's Assistant Manager of Engineering shows:

Why Loxarmor* is the low cost alternative to conduit

Rubber-insulated Loxarmor* cables provide an ideal combination of flexibility, light weight and mechanical strength. Where rigid conduit is not desired, Loxarmor is the No. 1 alternative for either power or control circuits. Here's why:

Material and installation costs are lower. Eliminates conduit and related installation procedures such as making bends and using pull boxes. It is especially useful in cramped quarters.

Circuits are easily added or re-routed—usually trained in trays or racks, Loxarmor cables can be easily moved.

Easy accessibility reduces down-time—permits quick inspection. Can be installed indoors and outdoors.

Loxarmor occupies less space—not much more than half the space is required for multiple Loxarmor circuits vs. circuits in conduit.

Loxarmor can be supplied over any standard Okonite insulation—depending upon your installation conditions and voltage requirements. It is available in galvanized or stainless steel, aluminum, bronze or copper.

For dimensional data on Okonex (*one* of Okonite's standard rubber insulations) with Loxarmor plus splicing and terminating drawings and instructions, write for Bulletin PW-1090. The Okonite Company, Passaic, N. J.

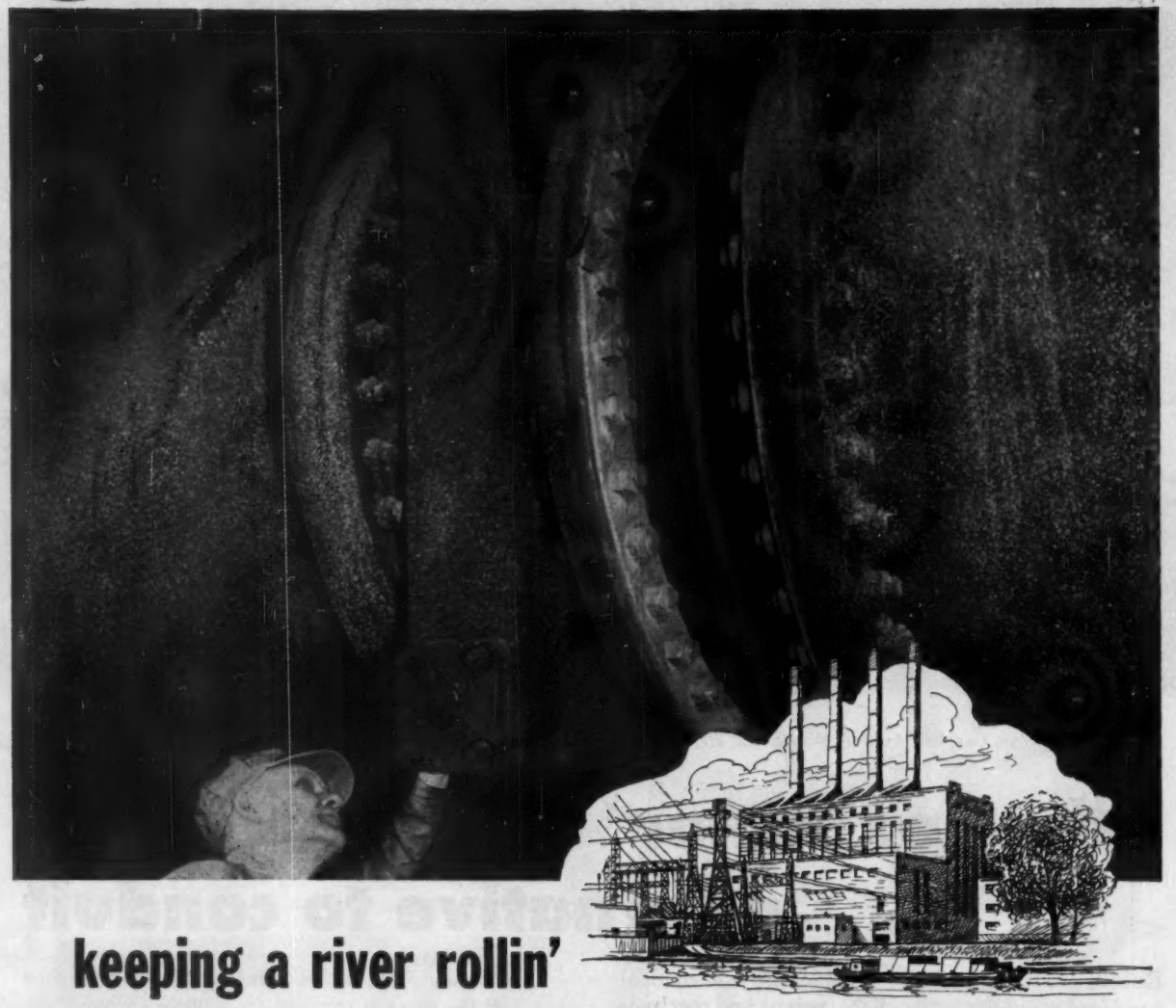
*Interlocking S-shaped armor

Available with either copper or aluminum conductors

4161

***where there's electrical power . . . there's* OKONITE CABLE**

EXPANSION JOINTS



keeping a river rollin' and the pipes from rockin'

A river of 390,000 gallons of water per minute rolls through the four surface condensers in Niagara Mohawk Power's plant at Oswego, New York. Here is generated enough power to heat 384,000 household steam irons every hour. Ravenous furnaces consume 3600 tons of coal every 24 hours at full load.

The piping in Niagara's condenser system can't rock or rattle itself to death despite the tremendous capacities and pressures encountered. U. S. Rubber Expansion Joints are the flexible connections that allow the pipes to give and take, to literally ride with the punch.

"These Expansion Joints were installed in 1940," says the plant superintendent, "and they've never given us trouble. We use them in sizes from as small as 6" all the way up to 48", and at water temperatures up to 170 degrees Fahrenheit. We know we will get many more years' wear out of them."

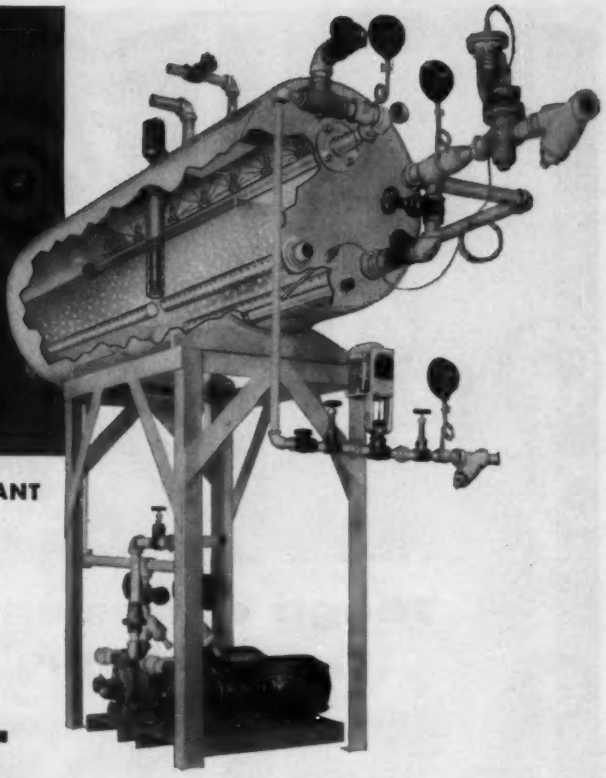
To absorb excess stresses due to expansion and contraction, to insulate against vibration, take care of misalignment, specify U. S. Expansion Joints. They are available at any of the 28 "U.S." District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

Watch NCAA football, Saturday afternoon, NBC-TV

Mechanical Goods Division

United States Rubber

SCHAUB "03" DEAERATOR



FOR THE SMALL TO MEDIUM STEAM PLANT

- **Combats "Return Line" Corrosion**
- **Guarantees Oxygen Removal to .03 cc/liter**
- **Simpler in Principle and Operation**
- **Pays for Itself in Savings**

HOW TO CUT CORROSION COSTS

without Breaking Your Budget

If your steam needs are in the 3,000 to 30,000 lbs./hr. range the Schaub .03 Deaerator was designed with *you* in mind.

It is in plants of this size range — often operating at low pressure — that "return line" corrosion is most likely to be a continual costly maintenance item. A Schaub .03 Deaerator effectively combats this and at very low cost. It is equally applicable to high pressure installations.

The *big* difference between the Schaub .03 and other low-cost deaerators is that it operates *fully vented* at atmospheric pressure for better gas removal. Yet wasteful steam vapor loss is prevented regardless of load variations by the simple, but effective Schaub spray-contact vent condensing method. Other exclusive features that boost efficiency are pin-point temperature control and "live action" heating of storage water. This provides more forceful "break-away" of air molecules.

With fully vented design, no premium-cost pressure construction is needed and maintenance and operating costs are reduced to a minimum. Rust-proof Chromosoid lining adds years of trouble-free life.

NOTE: For boiler capacities up to 100,000 lbs./hr. and .005 cc/liter oxygen removal, write for Bulletin *575*, describing the unique Schaub Zero-Oxygen Deaerator.

SEND FOR BULLETIN 1300

The full facts on the "hows", "whys" and basic differences in the Schaub .03 method. Filled with facts for the operating or consulting engineer responsible for boiler feedwater deaeration.

FRED H. SCHAUB ENGINEERING CO.

2105 South Marshall Boulevard • Chicago 23, Illinois

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

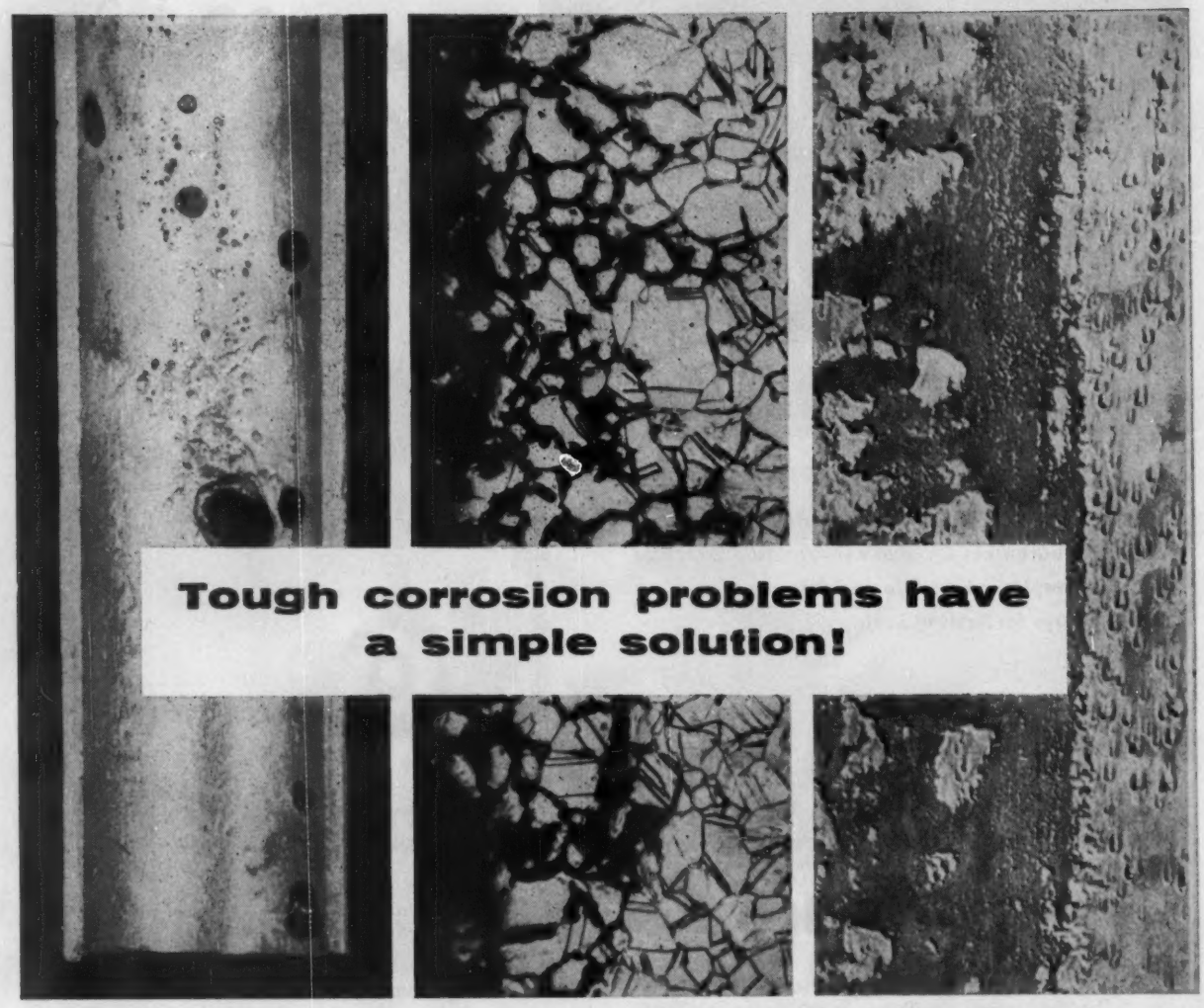
Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____



Tough corrosion problems have a simple solution!

Dezincification

Since 1935, when it was first introduced by Chase, there has *never* been a reported dezincification failure of Chase Antimonial Admiralty tube—and over one-hundred and twenty million pounds have been installed in heat exchangers and condensers!

Intercrystalline Corrosion

Both Chase Antimonial and Chase Cupro-Nickel are highly resistant to intercrystalline corrosion. Alloying elements are properly distributed, grain size carefully controlled, internal stresses minimized—throughout every length of tube!

Impingement

Even turbulent, high-velocity salt water flow is stymied from destructive cavitation in Chase Cupro-Nickel tube. This alloy forms a tough protective oxide film on its surface that strongly resists those horseshoe-shaped impingement pits!

Get full details on *all* Chase heat exchanger and condenser tube alloys.
Write for Free 54-page manual: CHASE Condenser and Heat Exchanger Tubes!

Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

SOLID WHEEL

spells non-stop turbine performance

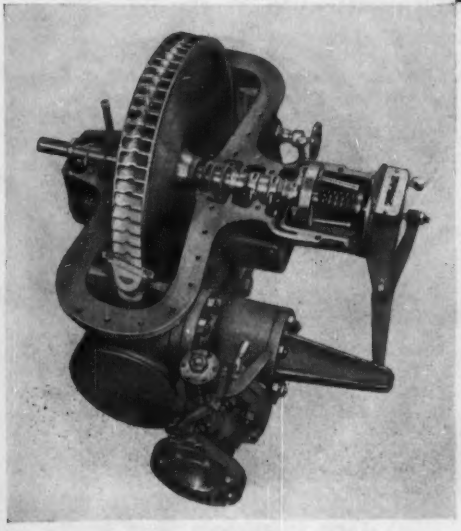
It's easy to see why Terry solid-wheel turbines have been setting non-stop records. They're built for long periods of continuous service.

The rotor, for example, is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out.

What's more, the blades can't foul. There is a one-inch clearance on either side of the wheel and the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

You, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives full details. Send for a copy today.

THE TERRY STEAM TURBINE CO.
Terry Square, Hartford 1, Conn.



Action of steam in a Terry solid-wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TT-1205

TERRY

The Case of WASTED HORSEPOWER

or

"Over-motoring" is outmoded by Dow Corning Silicones

SCENE: Pump room, Anyplant, U. S. A.

CHARACTERS: TINY H.—a 5 hp Class H motor insulated with Dow Corning Silicones. BLUSTER A. — a 7½ hp Class A motor.

TINY H: You're goofing-off again! Why don't you try moving a bigger load now and then?

BLUSTER A: Nuts to you, Tiny. I'm working hard enough keeping this little pump going.

TINY H: But you're strong enough to drive a bigger pump . . . or are you?

BLUSTER A: That's enough. I should worry—the engineers who put me here figured I might have to carry a 6 hp load—er—once in a while, at least.

TINY H: Sooo what! I'm rated to match our average load. My silicone insulated innards give me extra muscles to carry any overloads. Why—I could pump a 7 hp load and still be here when you're dead and gone.

BLUSTER A: Shut up, Tiny! Somebody might hear you.

TINY H: Okay, fat stuff, but you can't hide the facts forever. Mark my nameplate—one of these days the boss will figure out how much money you're wasting and you'll have had it.

You can match the load . . .
let Silicones carry the overload

Lazy motors cost money! Why continue to pay a fat premium for motors that make kid's play of their average work load? Today, you can save money by using silicone insulated motors rated to match your average load. Their built-in service factor of 25 to 50% will handle most intermittent overloads or loads that can't be matched in standard frame sizes.

Remember, over-motoring is outmoded

Get sources for silicone insulated equipment—mail coupon today

Dow Corning Corporation, Dept. 6911, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

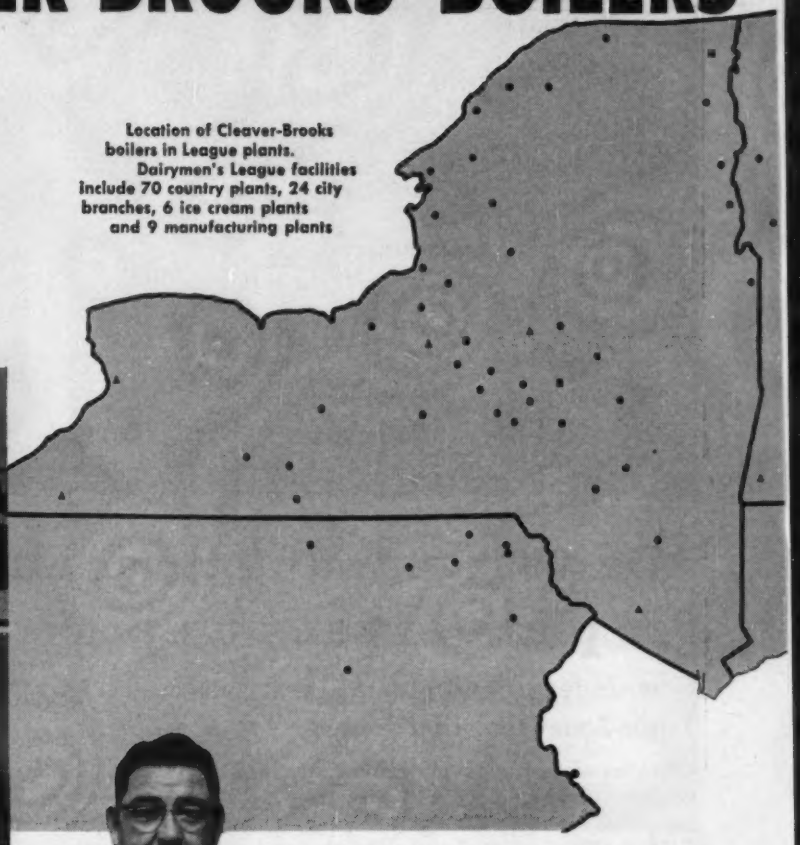
ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

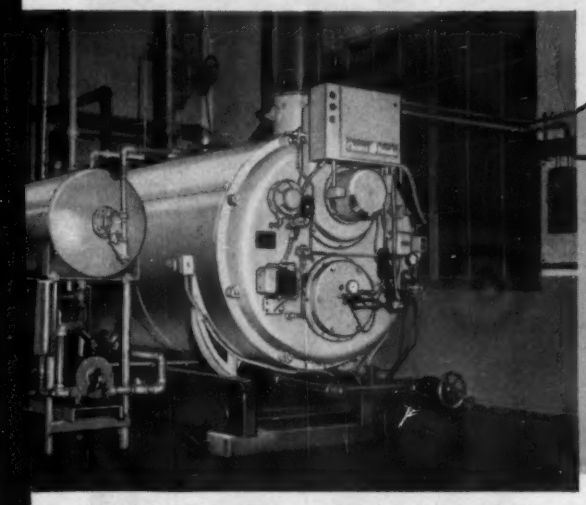
One of America's largest and leading dairy associations uses

69 CLEAVER-BROOKS BOILERS

Special note to dairymen:
See Cleaver-Brooks boiler exhibit at the Dairy Show, ATLANTIC CITY Oct. 29 — Nov. 3. Booth W.50



Location of Cleaver-Brooks boilers in League plants. Dairymen's League facilities include 70 country plants, 24 city branches, 6 ice cream plants and 9 manufacturing plants



MILTON, PA. — This country plant is supplied with quick, dry steam from a Cleaver-Brooks 60 hp light-oil fired CB boiler.

"Our 69 Cleaver-Brooks boilers are a key part of our production — their unusually high efficiency, sanitary, clean operation have helped us grow and prosper", says Ken Dodge, staff engineer for Dairymen's League Cooperative Association.

"Maintenance is low. We average far less than one service call per boiler per year," he adds.

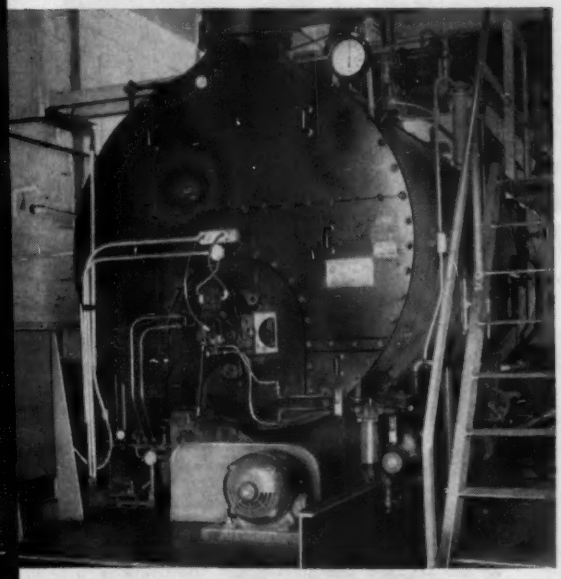
Dairymen's League Cooperative Association, serving 25,000 dairy farmers and thousands of consumers in New York, Pennsylvania and New Jersey, has been a steady user of Cleaver-Brooks boilers for 20 years.

Like any dairy company, the League finds steam essential for the production of quality dairy products. Their boilers are the work horses of their plants — supplying steam for pasteurizing, heating, cleaning and processing.

And Cleaver-Brooks boilers, with their exclusive four-pass, forced draft design and clean, quiet operation are especially suited to dairy plant operation.

Famous dairies the country over are profiting with the many advantages of Cleaver-Brooks boilers, available in a complete line. You can select from 110 models in 18 boiler sizes, 15 through 600 hp . . . oil, gas and combination oil and gas fired.

For more information contact your nearby Cleaver-Brooks representative. Or write Cleaver-Brooks Company, Dept. M, 301 E Keefe Avenue, Milwaukee 12, Wis. Cable Address: CLEBRO — Milwaukee — all codes.



UTICA, N.Y. — In this city plant a 250 hp LR heavy-oil fired boiler provides all steam for pasteurizing, cleaning, heating and processing.

Cleaver Brooks

ORIGINATORS · OF THE SELF-CONTAINED BOILER

INSTALLING CONTRACTOR: O. A. WENDT COMPANY, CHICAGO

1300 FEET of trench were needed, without special preparation or forms. Note simple concrete supports—no anchors are evident.

EXPANSION LOOP demands only additional GILSULATE on one side of each loop leg in the direction of expansion.

Midwest manufacturer chooses GILSULATE® for plant expansion program

New underground steam lines protected with Triple-Zone insulation system

When one of the world's largest manufacturers of heavy-duty engines expanded plant facilities, the company chose GILSULATE to insulate and protect their hot underground piping system. They knew that GILSULATE gives maximum insulation and corrosion protection against commonly-encountered underground conditions. And they knew too that GILSULATE's low cost for the *complete* installation could not be matched by any other underground pipe insulation.

This typical GILSULATE installation runs for 1300 feet from the plant's main boiler room to the new parts building. Included in the system are a 14-inch steam line, an 8-inch steam line, and a 6-inch condensate return. The line carries 150 pounds of steam pressure with superheat.

Your local GILSULATE distributor will be glad to show you all of the advantages of the modern, efficient GILSULATE Insulation System. Complete details are yours for the asking. Write the office nearest you today.

GILSULATE IS POURED AND TAMPED easily and quickly. Leap frog sheet metal forms conserve material; bulldozer handles backfill.

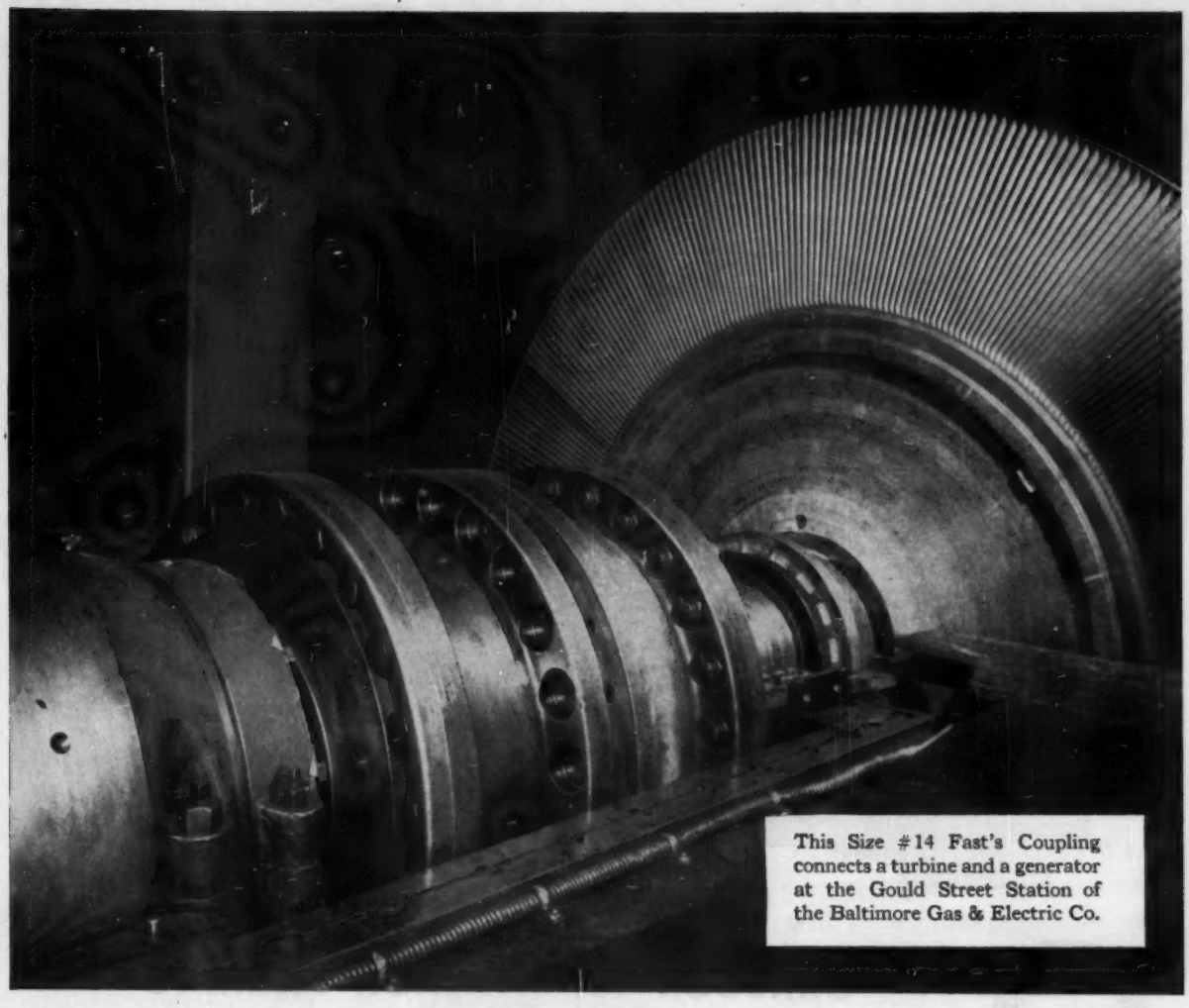
Facts about Gilsulate

1. **EASY TO USE**—just pour and tamp... pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS:** no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING:** for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220°-300°F. temp. range
   Type B for 300°-385°F. temp. range
   Type C for 385°-520°F. temp. range

THE TRIPLE-ZONE INSULATION SYSTEM FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California
OFFICES AT: 134-F West Broadway, Salt Lake City, Utah
1145 East Jersey Street, Elizabeth 4, New Jersey
The Agents Building, 3537 Lee Road, Cleveland, Ohio



This Size #14 Fast's Coupling connects a turbine and a generator at the Gould Street Station of the Baltimore Gas & Electric Co.

This Fast's Coupling runs smooth after 29 years of service!

This Size #14 Fast's Coupling has never had a major part replaced since its installation on January 4, 1927.

The Baltimore Gas & Electric Company has provided excellent care and inspection . . . examining the coupling during each routine overhaul of the turbine and generator. The last inspection (shown above) was during the fall of 1955.

Unique design permits Fast's Couplings to compensate for both offset and angular misalignment of shafts and eliminates the wear of metal upon metal. It provides positive lubrication which forms a film on load-carrying surfaces of the teeth. Metal bearing rings located at the mid-axis of the teeth keep out dirt, grit and moisture—keep lubricant in. Fast's metal-to-metal seal protects the lubricant against pollution.

A Koppers engineer can show you how Fast's Couplings will give you extra years of service and reduce down-time. For more details, write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 3311 Scott Street, Baltimore 3, Maryland.

Koppers Company, Inc.
Metal Products Division
Baltimore 3, Maryland

***Engineered* Products**

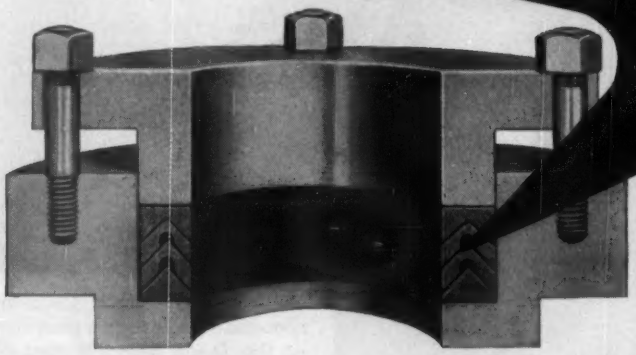
Sold With *Service*

KOPPERS

THE ORIGINAL *FAST'S Couplings*

ONE OF THE GARLOCK 2,000

SHALLOW STUFFING BOXES NEED THIS KIND OF "GRIP"



GARLOCK 431 CHEVRON* PACKING

for use on reciprocating rods and rams, tightens as pressure increases, eases off as pressure decreases, assuring no-leak sealing and minimum friction.

LOOK AT THESE SERVICE REPORTS:

- On hydraulic press with 40" dia. ram, operating at 6000 psi pressure, .006" clearance between ram and gland, GARLOCK 431 CHEVRON size 40" x 41½" by only 2" deep gave 14 years service.
- On hydraulically operated clutches with ¾" cylinder, 500 psi pressure, ¾" travel, operating intermittently. Neither leather cups nor "O" rings worked well. Now packed with GARLOCK 431 CHEVRON ⅜" x ¾" x 17/32" deep. Result: smooth, positive sealing.

And remember, 431 CHEVRON Hydraulic Packing is only one of "the famous GARLOCK 2,000" ... two thousand different styles of packings, gaskets, and seals to meet *all* your needs. It's the *only* complete line ... it's one reason you get unbiased recommendations from your GARLOCK representative. Call him today or write for Folder AD-115.

**Registered Trademark*

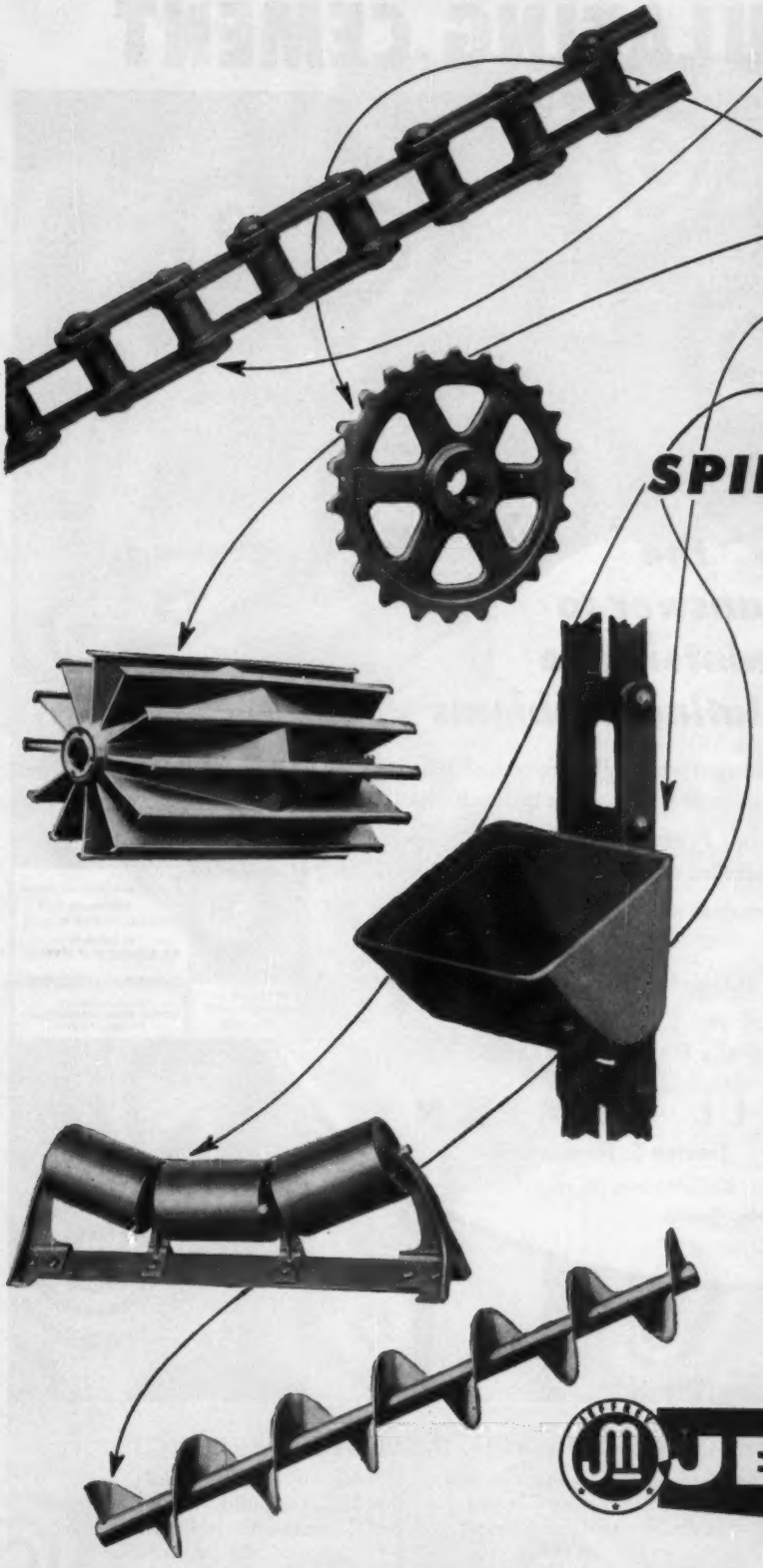
THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, *contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.*

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

Specify **JEFFREY** when you replace



CHAINS
SPROCKETS
PULLEYS
BUCKETS
IDLERS
SPIRAL FLIGHTS

YOUR Jeffrey distributor can supply the units you need for replacing worn parts and modernizing old equipment. Your materials-handling and power-transmission machinery will give more efficient, economical operation when you use these time-tested, dependable products.

Jeffrey replacement parts have the same sound design as those used on original equipment. All are designed for maximum service. Materials and workmanship are the finest. Jeffrey District Offices and Distributors are located in all principal cities. The Jeffrey Manufacturing Co., Columbus 16, Ohio.

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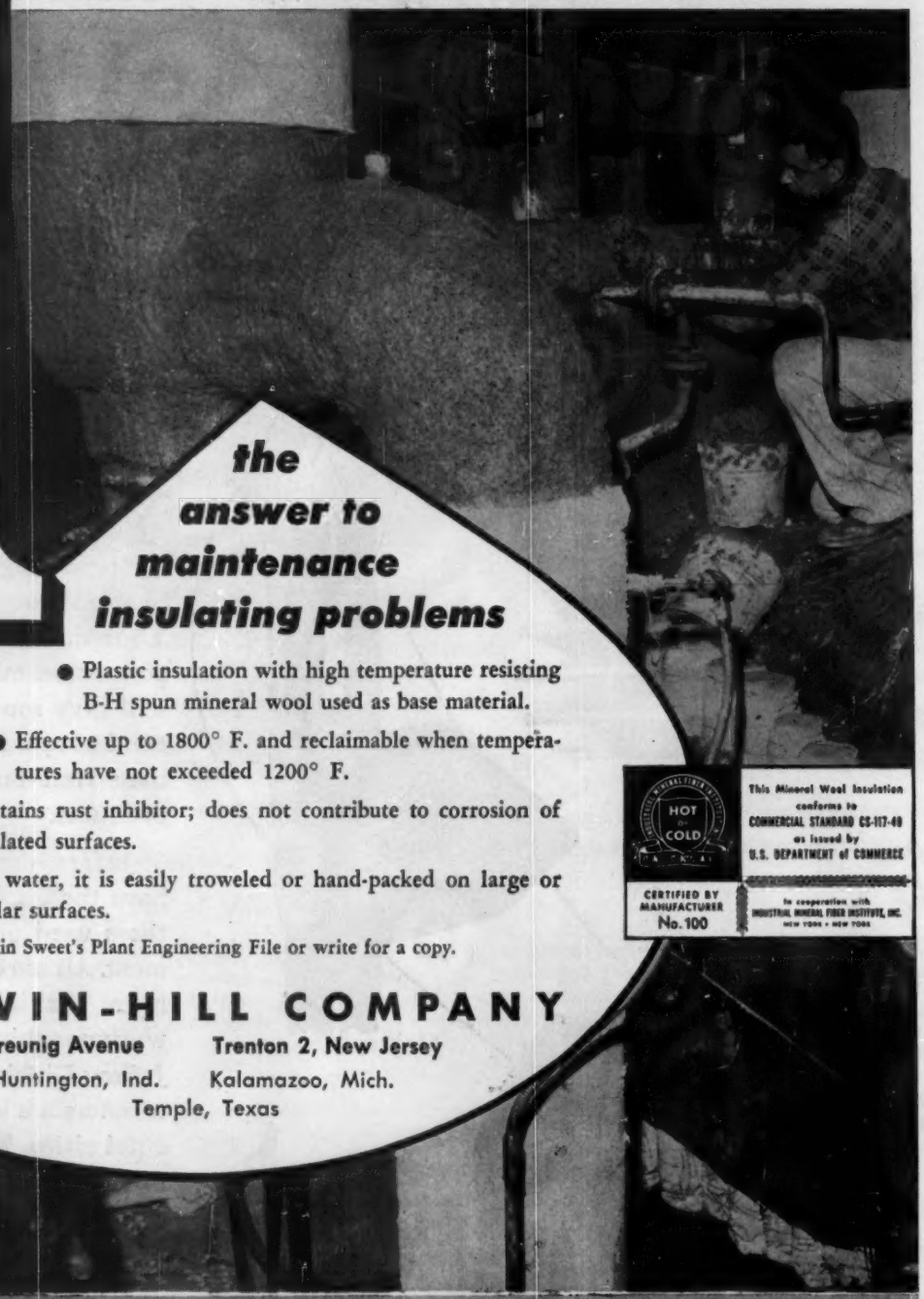
CONVEYING · PROCESSING · MINING EQUIPMENT · TRANSMISSION MACHINERY · CONTRACT MANUFACTURING

No. 1 BALDWIN-HILL INSULATING CEMENT



the answer to maintenance insulating problems

- Plastic insulation with high temperature resisting B-H spun mineral wool used as base material.
- Effective up to 1800° F. and reclaimable when temperatures have not exceeded 1200° F.
- Contains rust inhibitor; does not contribute to corrosion of insulated surfaces.
- Mixed with water, it is easily troweled or hand-packed on large or small irregular surfaces.

HOT COLD

This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-48 as issued by U.S. DEPARTMENT of COMMERCE

CERTIFIED BY MANUFACTURER No. 100

In cooperation with INDUSTRIAL MINERAL FIBER INSTITUTE, INC. NEW YORK • NEW YORK

See our catalog in Sweet's Plant Engineering File or write for a copy.

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BALDWIN-HILL BH INSULATIONS

COMPLETE LINE OF BALDWIN-HILL INSULATING PRODUCTS

B-H Mono-Block	B-H Super Powerhouse Cement	B-H No. 100 Pipe Insulation
B-H Blanket	B-H No. 1 Insulating Cement	B-H 85% Magnesia Pipe Insulation
B-H Koldboard	B-H No. 52 Asbestos Cement	B-H Calcium Silicate Pipe Insulation
B-H Bond-Tite	B-H Spun Felt Insulation	B-H Mono-Kover Pipe Insulation
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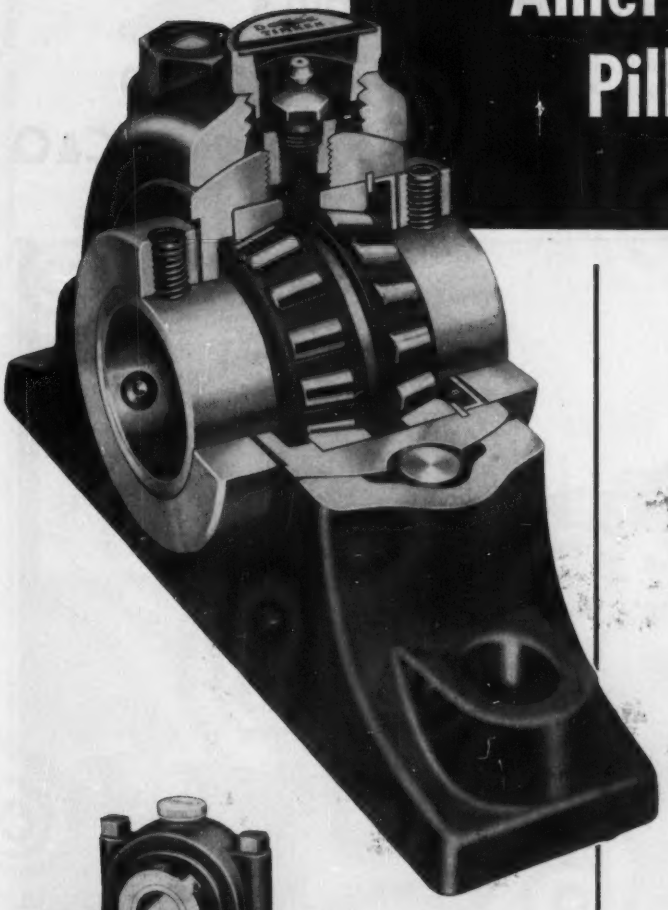
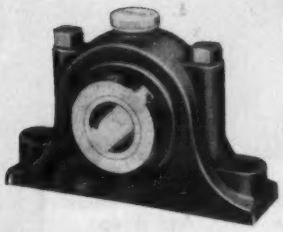
AVAILABLE IN FIVE TYPES
FOR ALL KINDS OF SERVICE

DODGE-TIMKEN
America's Quality Pillow Block





- COMPLETELY ASSEMBLED
- FACTORY ADJUSTED
- PRE-LUBRICATED

Call the Transmissioneer, your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write us.

DODGE-TIMKEN Bearings are adjusted, lubricated and sealed at the factory. Labrynth seals effectively retain the lubricant and prevent the entrance of dust and dirt. The inbuilt precision of Dodge-Timken Bearings is protected both on and off the shaft. They are delivered fully assembled, ready to mount.

Where service conditions are toughest Dodge-Timken Bearings prove their quality decisively. For superior performance, dependability and long life they have won their reputation throughout industry as America's quality pillow blocks.

To meet varying service requirements Dodge-Timken Pillow Blocks are available in five types—the type E . . Double Interlock (illustrated) . . Type C . . Special Duty . . . and All-Steel. Available in a range of shaft sizes from 1-3/16" to 10".

Call your Transmissioneer; or write for Bulletin A638 giving load ratings, dimensions and other data on Dodge-Timken Roller Bearings.

DODGE MANUFACTURING CORPORATION
3200 Union Street, Mishawaka, Indiana

DODGE
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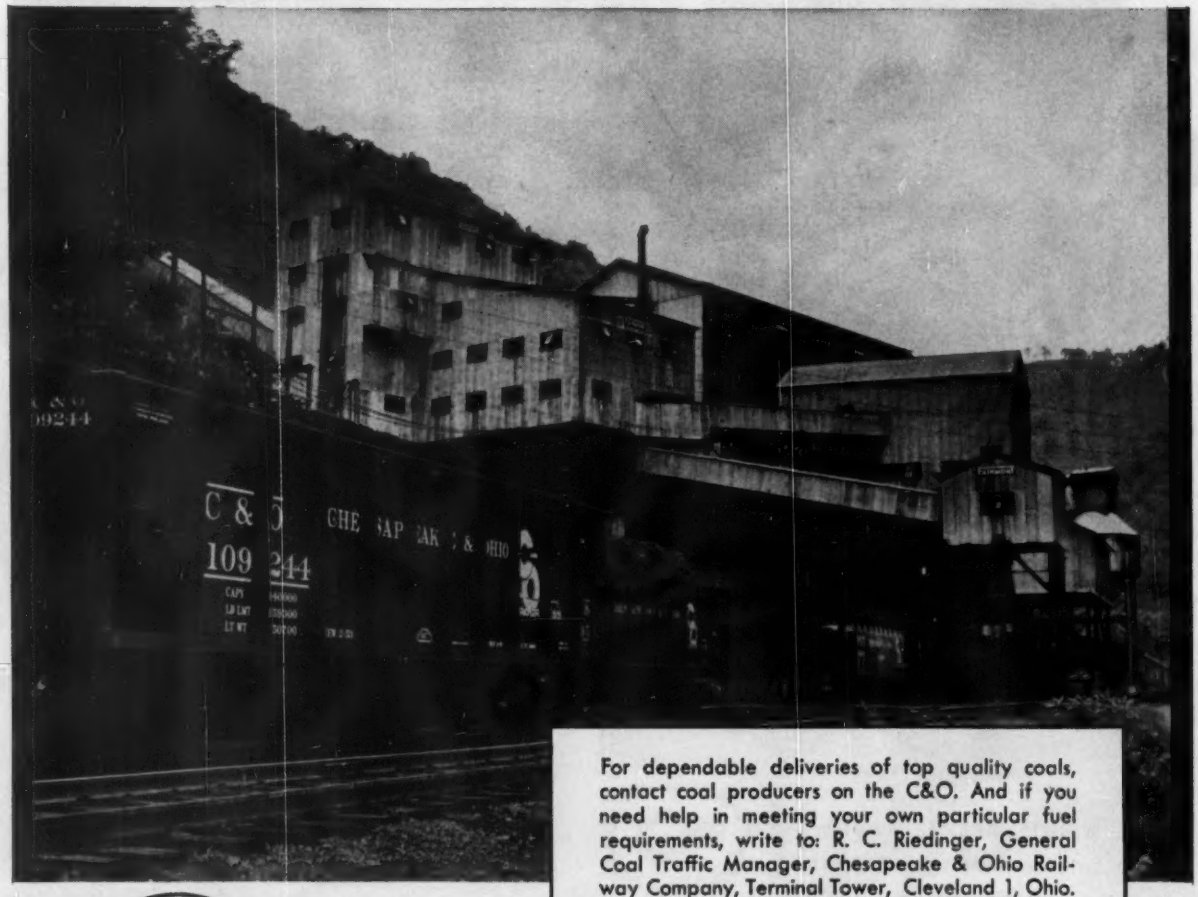
Coal ... low in sulphur
... low in ash
... low in moisture

Coal ... HIGH in btu's
... HIGH in satisfaction
from producers on the C&O



For dependable deliveries of top quality coals, contact coal producers on the C&O. And if you need help in meeting your own particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

COMPLETE LINES OF WALWORTH VALVES for POWER PLANT SERVICE

Featuring Walworth Pressure-Seal Valves

Here are cast steel valves built for high-pressure, high-temperature service. The unique bonnet-to-body design utilizes internal line pressure for a tight, leakproof connection. The higher the pressure the tighter the bonnet joint! Bulky, heavy bonnet flanges, bonnet studs, and nuts are completely eliminated providing a modern valve design of truly streamlined proportions. Maintenance is simplified as Walworth Pressure-Seal Valves are easily assembled, disassembled, and insulated.

Walworth Pressure-Seal Valves are available in Series 600, 900, 1500, 2500, and in a wide range of sizes and types. Complete information is available from your nearby Walworth Distributor—or—write Walworth for for a free copy of Circular 16.

and including these valves for "*'round-the-plant*" use!

WALWORTH SMALL CAST STEEL Y-GLOBE VALVES. Simplified design eliminates many of the problems encountered in high-temperature, high-pressure service. No bonnet joint. Improved back-seat design means longer life for packing rings.

WALWORTH LUBRICATED PLUG VALUES. Easy turning—quick operating. Lubricant can be renewed while the valve is in service. Lubricant completely surrounds the plug ports for a tight seal against leaks. Remember, always use Walworth Lubricant in Walworth Lubricated Plug Valves.

WALWORTH BRONZE VALVES. Standardized lines of bronze valves provide an unsurpassed system of interchangeability of parts, drastically reducing inventory problems. Walseal Valves with brazing ends also available in a variety of types.

WALWORTH IRON BODY GATE VALVES. Straight-flow port design reduces fluid turbulence to a practical minimum. Seat rings of end-seated type are screwed into the body. Brass liner on glands assures greater resistance to corrosion and scoring. Available with threaded or flanged ends.

WALWORTH CAST STEEL GATE VALVES. Bolted bonnet, wedge gate, OS&Y. Bonnets and bodies are engineered to withstand pressure and minimize distortion. Heavy steel walls provide extra strength and longer life. Deep stuffing boxes in all sizes (2" to 24") insure tightness and maximum packing life. Also available in globe and angle types.

WALWORTH also offers Plastic Valves, Fittings, *and* Pipe of polyvinyl chloride, moulded to Walworth's specifications by General American Transportation Company of B. F. Goodrich Chemical Company Geon!

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Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

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See how straight reciprocal drive eliminates major replacement part problems.

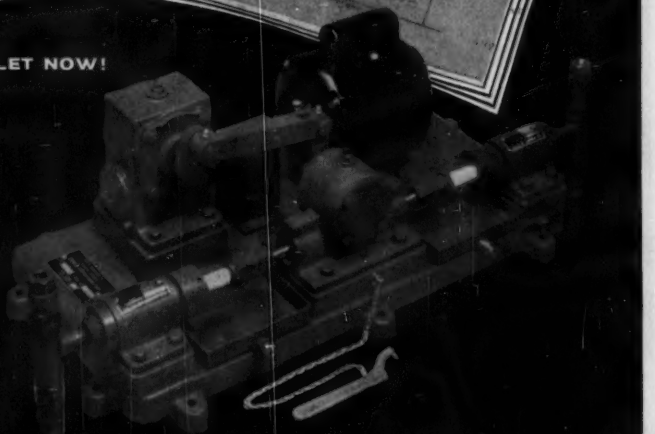
See how Hills- McCanna design gives you greater dependability, accuracy and longer pump life.

See how Hills- McCanna metering pumps can meet your exact requirements.

SEE HOW A *new heart* PUTS *new life* IN YOUR WATER TREATMENT SYSTEM!

SEND FOR THIS NEW FACT-FILLED BOOKLET NOW!

Here's useful information to help you get more from your present water treatment system . . . to help you in the selection of the proper metering pump for your particular application. This big 12-page booklet is complete with technical information, installation drawings, tables of capacities and pressures, and pump construction recommendations for metering all types of liquids. It's like having a consulting engineer at your fingertips! Write for your copy now!



HILLS-McCANNA COMPANY

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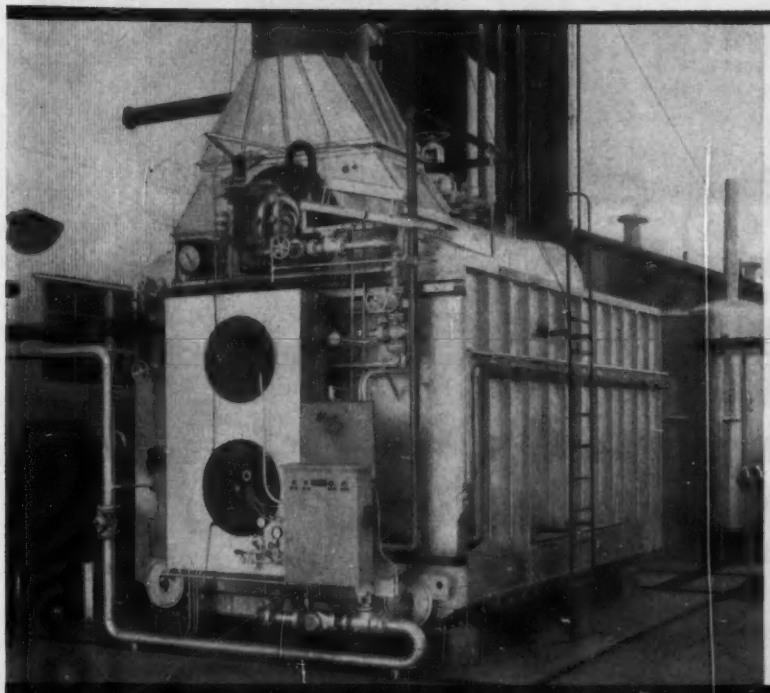
METERING AND PROPORTIONING PUMPS • DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

UNION PACKAGED BOILERS

give Tri-Valley the steam it needs to pack 3,200,000 cases of canned food



30,000 lbs. of steam per hour — that's the capacity of this Union Type MH Steam Generator serving Tri-Valley's San Jose cannery. It's part of a complete boiler plant designed and constructed by Union's West Coast affiliate, Union Iron Works of California, Inc.

PEAR-LADEN CONVEYORS keep production on the move inside Tri-Valley's San Jose plant.

BIRD'S EYE VIEW of Tri-Valley's Modesto plant which utilizes a 30,000 lb./hr. Union Packaged Boiler for process steam.

Producing 24 varieties of canned foods, Tri-Valley Packing Association is one of California's largest independent canners. In 1955, it packed 58,000 tons of raw fruits and vegetables... *3,200,000 cases!*

Providing steam for the canning process as well as for operating cannery process equipment in each of Tri-Valley's two recently-modernized plants is a 30,000 lb./hr. Union Type MH Packaged Steam Generator.

In 1953, Tri-Valley's first MH Unit went to work in the Modesto plant. When the Association's San Jose plant needed a new boiler in 1955, another Union MH Packaged Boiler was picked for the job. Says Tri-Valley, "Our selection was based upon our evaluation of the design... and the performance of the Union MH Packaged Boiler installed in our Modesto plant."

The efficiency of the new Union Generator at the San Jose plant has been checked at 77.88% on gas firing at 33,000 lbs./hr., which is 10% over rated maximum continuous output.

From coast to coast, Union Packaged Steam Generators are stacking up impressive job records in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals, to name but a few.

Completely shop-assembled at Union Iron Works for delivery via rail or truck, Type MH Units can be equipped to handle multitudes of needs formerly requiring costly field erection and special engineering. Standard units are designed in 13 sizes from 10,000 to 50,000 lbs. of steam per hour.

GET THE FULL STORY including cut-away illustrations, tube layouts and dimension tables by writing for Bulletin MH-353.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA

A Two extension coil springs hold assembly against shaft.

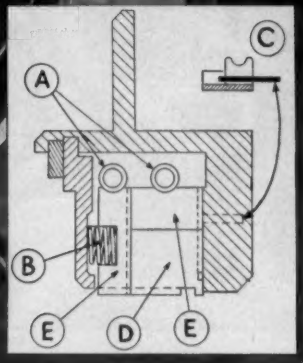
B Axial compression springs exert constant positive pressure toward the sealing face.

C Key and pin assemblies lock carbon segments against rotation.

KOPPERS CIRCUMFERENTIAL SEAL

PROVIDES UP TO 2000 hrs. OF PERFORMANCE

CAN USE LESS THAN 5 h.p.



D Flexible sealing segments permit seal to achieve same circularity as shaft.

E Straight-cut joints are covered and sealed by segmental cover ring and segmental back ring.

A number of finite joint gaps allow for ring wear.

Koppers Circumferential Seal is a segmented carbon seal ring with straight-cut joints. Its design can be modified to use step type joints or step seal joints. Primarily a gas seal, the Koppers Circumferential Seal will seal liquids if the geometry of the shaft mating faces is changed.

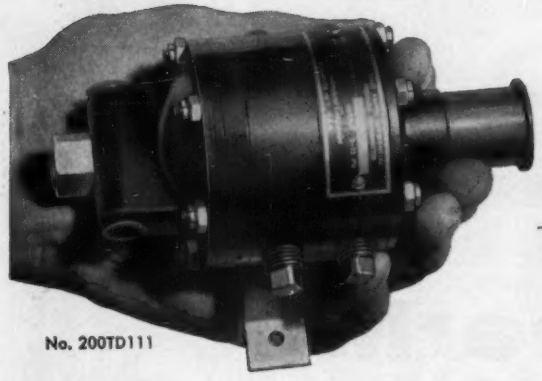
Koppers Circumferential Seals are one of a large variety of seals designed and manufactured by Koppers for every industrial use. Because of this complete line, Koppers can recommend, without bias, the seal best suited to your specific application. And Koppers continuous development and testing of new designs and new materials assure you of the most advanced, most efficient seals for your purpose. If you have a sealing problem, write to the KOPPERS COMPANY, INC., Metal Products Division, Piston Ring and Seal Department, 2111 Scott St., Baltimore 3, Maryland.

Engineered Products Sold with *Service*

KOPPERS

MECHANICAL SHAFT SEALS

"That new Taylor Instrument's saving us money already!"



No. 200TD111

He's talking about the new Taylor low-cost Flow Transmitter!

THE reason he can spot the savings so quickly is that the No. 200TD111 Fixed Range Differential Pressure Transmitter is being used to measure departmental consumption of steam, air and water that previously went unchecked. That 3-pen recorder in the background shows at a glance how much is being used by a given department as a basis for apportioning costs. It's the remarkably low price of this new instrument that makes it such a practical cost accounting aid on applications hitherto considered marginal.

Measuring only 6½" x 3" and weighing only 4½ lbs., its simplified piping, force-balance construction and external adjustments make it easy to install and maintain. Calibration accuracy is better than 1%. Sensitivity exceeds 0.1%. Ranges 0 to 50, 100, 200 and 300 inches of water. Built for rough service and outdoor mounting.

Call your Taylor Field Engineer, or write for **Bulletin 98274.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

DESIGN SPECIFICATIONS

Diaphragm of Neoprene-impregnated Nylon.
Body material, brass.
Maximum working pressure: 150 psi.; temperature 150°F.
Air Supply pressure, 20 psi.
Air consumption, 0.10 standard cu. ft. per minute.
Output pressure range 3 to 15 psi.
Size 6½" x 3". Weight 4 lbs. 9 ozs.
All connections ¼" internal NPT.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

NEW

from K·M *Best in asbestos*®

KaytherM®

PIPE INSULATION

Highly efficient from 250° F. to 1350° F.

LIGHT IN WEIGHT *for easiest handling.*

EXTRA STRONG *to allow for job pre-fabrication.*

DIMENSIONAL STABILITY *helps prevent expansion-caused leaks.*

INSOLUBLE IN WATER, CHEMICALLY STABLE. *Ideal for outdoor use.*

Years of research by Keasbey & Mattison, insulation pioneers, have resulted in a new, highly efficient, pipe insulation made of lime and silica (hydrous calcium silicate) with asbestos fibers added for strength. It's called KaytherM and it's strong, light in weight, and easily handled and cut.

KaytherM Pipe Insulation comes in simplified thicknesses and in pipe sizes up to 33" in diameter. KaytherM is also available in block form.

AVERAGE PHYSICAL CHARACTERISTICS—(Bone Dry Basis)

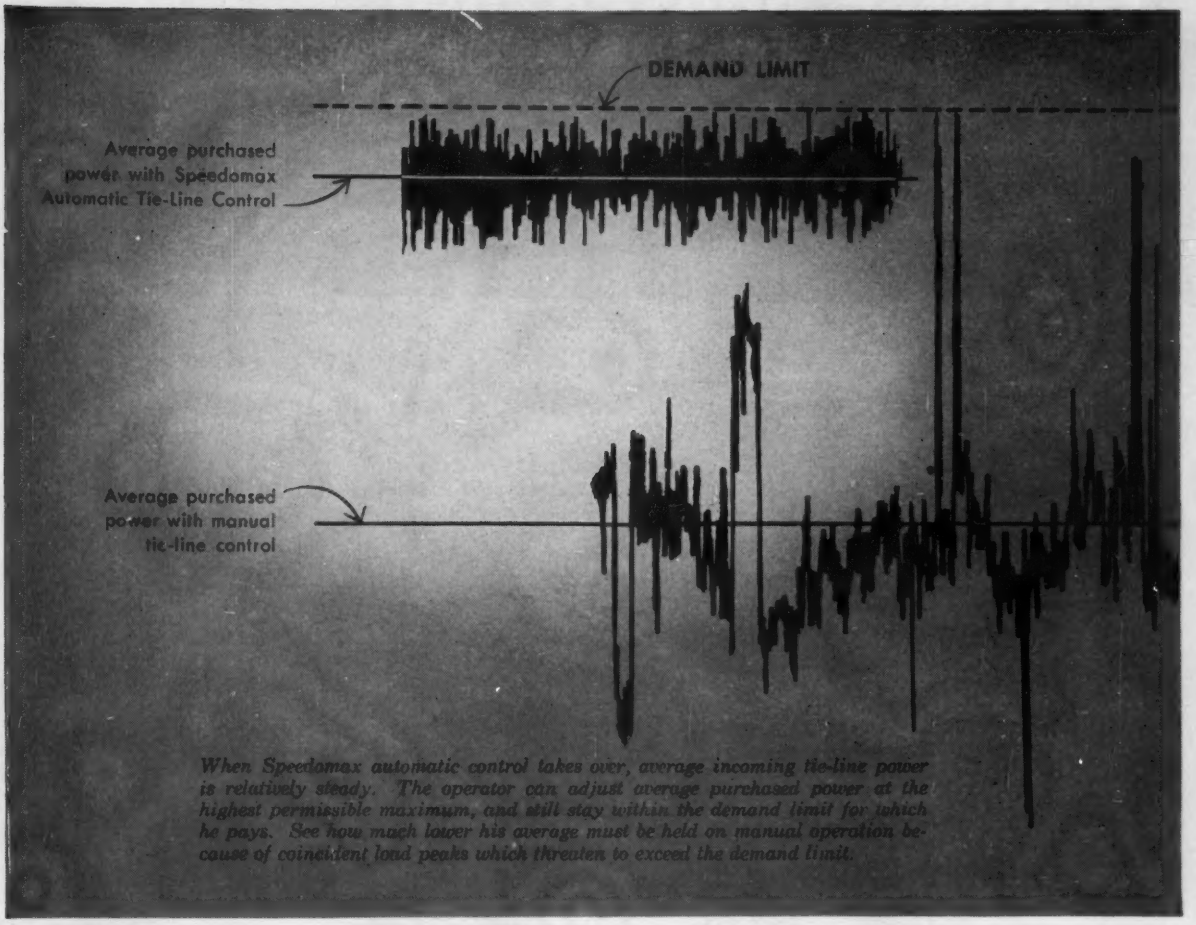
Temperature limit	1350° F.
Density, lbs./cu. ft.	11.5
Modulus of Rupture, lbs./sq. in.	65
"K" Factor at mean temperatures	100° F.—0.330
	400° F.—0.465
	800° F.—0.650

Write to us for full descriptive literature.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

In Canada: Atlas Asbestos Company, Limited; Montreal, Toronto, Winnipeg, Edmonton, Vancouver

ENGINEERS WANTED—Career opportunities open for men qualified in product development, machine design, automation, plant management, plant engineering and applied research. Write to Director of Engineering, Keasbey & Mattison Company, Ambler 4, Pa.

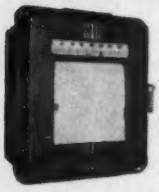

DEMAND LIMIT
Average purchased power with Speedomax Automatic Tie-Line Control
Average purchased power with manual tie-line control

When Speedomax automatic control takes over, average incoming tie-line power is relatively steady. The operator can adjust average purchased power at the highest permissible maximum, and still stay within the demand limit for which he pays. See how much lower his average must be held on manual operation because of coincident load peaks which threaten to exceed the demand limit.

Industrial Power Plant Engineers:

Look at the cost-saving difference

between Speedomax® automatic control and manual control



Operating and management people in industries making a diversity of products . . . machinery, paper, petroleum, textiles, chemicals . . . find that Speedomax automatic control cuts costs month after month. Here's why:

Speedomax electronic stability and mechanical stamina, relied on by a majority of utilities for their station control rooms and dispatcher's offices, assure fast—and lastingly precise—control action.

In industrial plants operating interconnected with a neighboring utility, this control action is provided by Speedomax Tie-Line Controllers to obtain economical purchased power, as shown above.

In plants operating isolated, this same control action enables Speedomax Frequency Controllers to hold frequency at an average of 60 cycles. In most cases, 24-hour time error is comparable to that obtained by the power companies themselves.

Write for the facts to Leeds & Northrup Company, 4914 Stenton Ave., Philadelphia 44, Pa. Better yet, talk with an experienced L&N Sales Engineer in any of 18 District Offices.

LEEDS & NORTHRUP
instruments *automatic controls* • *furnaces*

POSITIVE PROTECTION
AT ANY PRESSURE...
specify Consolidated

Get protection you can be sure of — whatever your working pressure. Specify Consolidated Safety Valves. Thousands of installations, in both large and small steam generating plants, attest to their complete reliability under all types of service conditions.

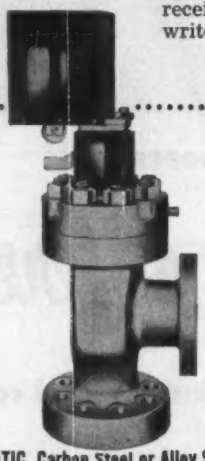
Many Consolidated Valves, with bronze body, are widely used for steam, air and water service; many more are installed in power plants as auxiliaries to Consolidated Steel Safety Valves. The cast iron and steel types are proving their dependability daily on low pressure boilers and those operated at super-critical pressures. The five different Consolidated Valves pictured here are representative types but the line is so complete, proper selection is no problem.

Consolidated Safety Valves are ruggedly built for long service life. Each type incorporates the fewest possible working parts for greatest efficiency. Precision craftsmanship assures positive, tight closing after operation. Through skillful engineering, valve adjustment and maintenance are made simple and easy. All these essentials contribute to outstanding performance, safety and economy.

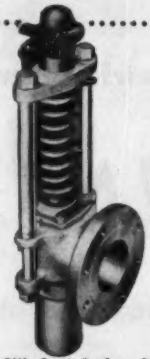
Just send us details of your particular service requirements and you will receive correct valve recommendations. Or write for Catalog 700A.

TYPE 1551. Cast Bronze Body. For package-type and fire tube boilers, air tanks and other classes of unfired pressure vessels. **Sizes:** ⅜" through 3". **Pressures:** up to 300 psi. **Temperatures:** up to 450° F.

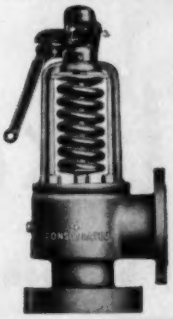
TYPE 1511. Cast Iron Body. An all-purpose safety valve for steam generator service. Cuts cost per pound of steam discharged. **Sizes:** 1½" through 6". **Pressures:** up to 250 psi. **Temperatures:** up to 450° F.



ELECTROMATIC. Carbon Steel or Alloy Steel. An electrically actuated relief valve for boiler service. Operable automatically, manually or cut out of service by setting remote control switch. Supplements spring-loaded safety valves — conserves power and increases efficiency of steam generating plants. **Sizes:** 2½" through 14". **Pressures:** up to 2500 psi. **Temperatures:** up to 1100° F.



MAXIFLOW. Cast Carbon Steel or Cast Alloy Steel. A safety valve with the greater discharge capacity and shorter blowdown demanded by high pressure, high temperature steam generators. **Sizes:** 1½" through 4". **Pressures:** up to 2500 psi. **Temperatures:** up to 1050° F.



TYPE 1415. Cast Steel Body. For water tube boilers, mechanically fired fire tube boilers, accumulators, unfired pressure vessels and pipelines. **Sizes:** ½" through 6". **Pressures:** up to 900 psi. **Temperatures:** up to 900° F.

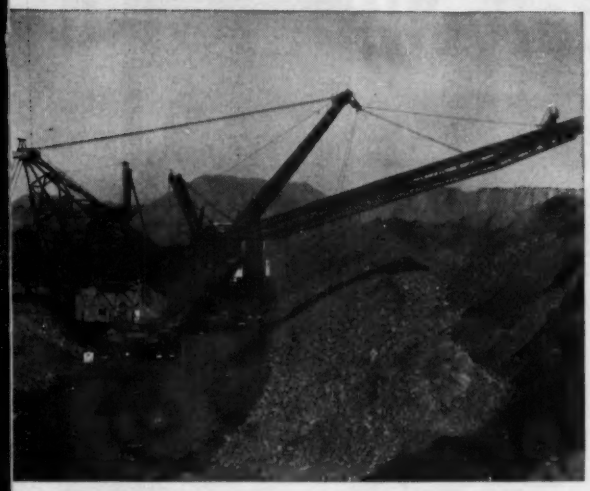
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

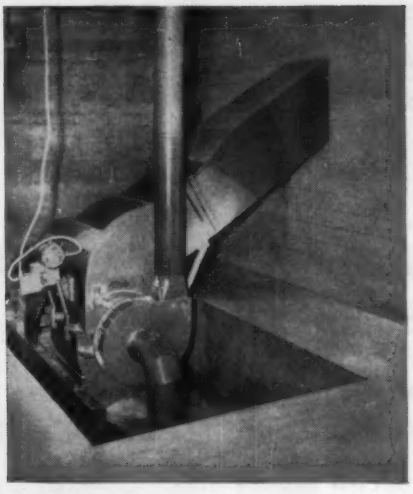
HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS...



Lower-Cost Dirt. This mammoth coal stripping machine scoops out 2000 cu. yds. of overburden an hour, cuts the cost of stripping coal that lies under 50 to 80 ft. of overburden. Its 22-ft. wheel carries eight buckets, each 4 ft. wide, with lips of 2½-inch USS "T-1" Steel. USS "T-1" Steel has the strength and toughness to scrape through shale, rock, mud, and ram into ton-and-a-half boulders day in and day out. In addition, it is weldable in the field, costs less than other steels that could be used—and outlasts them. This wheel excavator was designed by United Electric Coal Companies, Chicago, for their own use.

Moloney Saves A Ton. The size of everything had to be reduced on this new, smaller-than-ever portable transformer designed by Moloney Electric Company, St. Louis, Missouri. Over a ton of weight was saved in the tank alone by building it of ¼-inch USS "T-1" Steel instead of ⅜-inch carbon steel. The very high strength of this heat-treated alloy steel made possible this 25% saving in weight. The excellent weldability of USS "T-1" Steel was important, too, because this portable transformer is permanently welded to the bed of a semi-trailer. This particular unit was designed for Oklahoma Gas & Electric Corporation. Shell was fabricated by Nooter Corporation, St. Louis.

Heavier Loads, More Production. Mack Welding Company, Duluth, Minnesota, has used USS "T-1" Steel to increase the durability and at the same time reduce the weight of its Orange Peel Type, Four Tine Pulpwood Grapples. With these new, lightweight grapples, crane operators can handle increased payloads with present cranes. As a result, production can be increased as much as 40 percent.



Shucks, hay fodder, corn cobs, and grains are extremely abrasive when sucked out of a hammermill at high speed. And the blades of the fan that does the sucking must be able to withstand the abrasion and must be weldable. Myers-Sherman Company, Streator, Illinois, manufacturers of industrial hammermills, now make these fan blades from USS "T-1" Steel and save $7 on fabrication of each fan. USS "T-1" Steel provides all the needed durability, as well as good weldability.

HOW IT CAN HELP YOU

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking severe impact and abuse at sub-zero temperatures. Its excellent weldability can help you cut the cost of fabricating high strength parts, and to reduce repairs and maintenance expense.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Room 5415, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

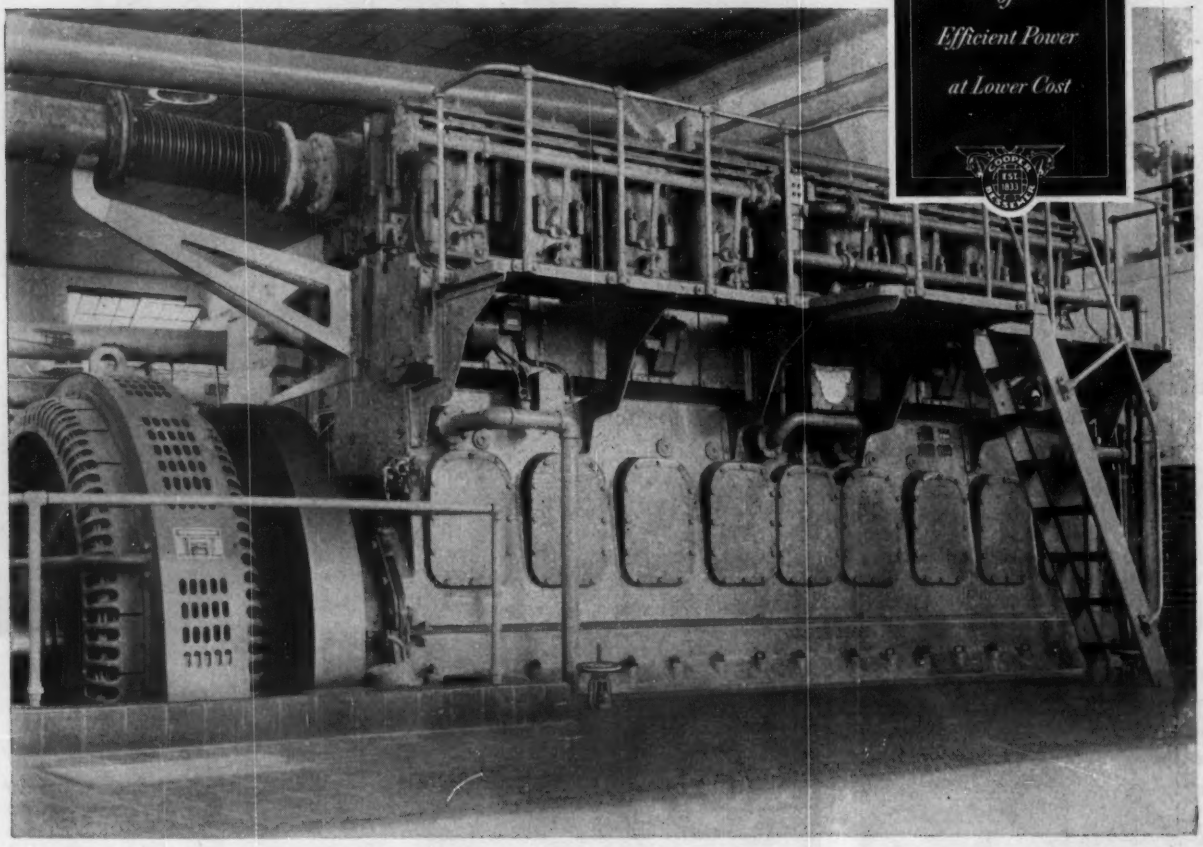
USS "T-1" CONSTRUCTIONAL ALLOY STEEL

See The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

Another Example of Efficient Power at Lower Cost

• Here's the 8-cylinder Cooper-Bessemer LS engine, rated 900 hp at 300 rpm, in operation at the Robstown, Texas Light Plant.



Here's the COOPER-BESSEMER PERFORMANCE STORY at Robstown, Texas

- *Never Re-Rung During 36,000 Operating Hours*
- *12,000 Hp. Hours Per Gallon of Lube Oil*
- *In Operation 6,700 Hours on One Set of Spark Plugs*

• The performance of this husky, 8-cylinder Cooper-Bessemer LS engine at the Robstown, Texas Light Plant is mighty good, but really not unusual for Cooper-Bessemers. It's just additional proof of their efficient, lower cost operation.

Remember, Cooper-Bessemer Diesels, gas-diesels and gas-engines are built for all types of heavy-duty stationary or mobile service. Wherever you find Cooper-Bessemers, you can be sure of smooth, economical, trouble-free power.

Find out from the nearest Cooper-Bessemer office how you can meet power needs in the 200-5000 hp range, at the lowest possible cost.

MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

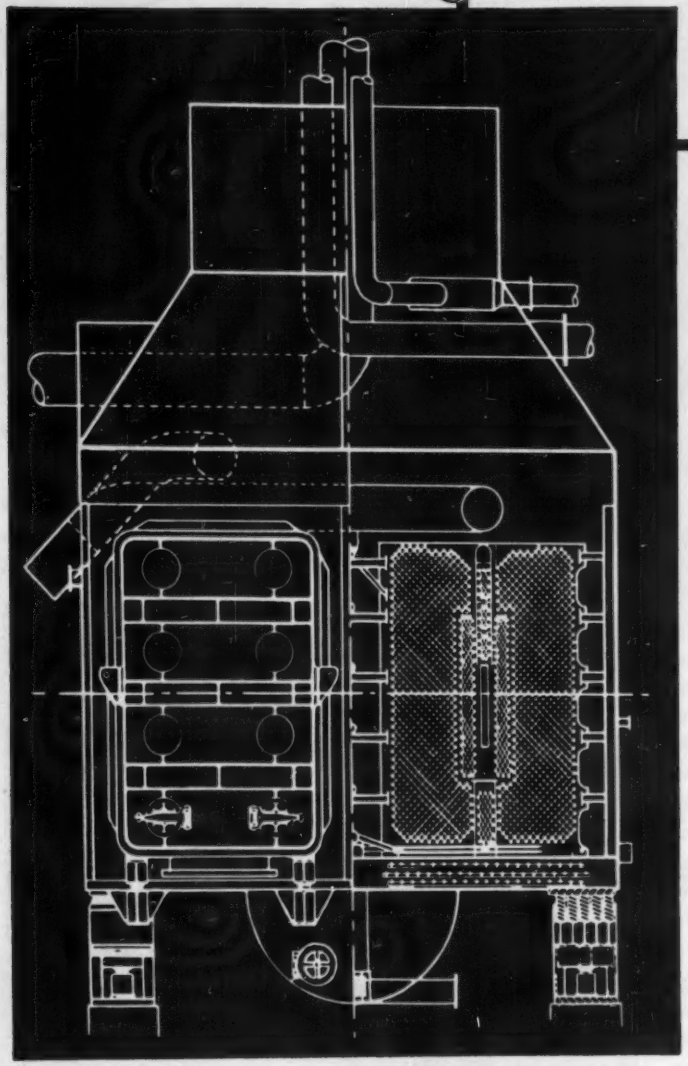
New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

DUAL BANK Condensers

by C. H. Wheeler

For Your Electric Generating Plants of Tomorrow



- Specifically designed for larger, more efficient electric generating stations.
- Adaptable to your station layout.
- Designed to minimize field erection problems.
- Additional steam lanes shorten path and resistance to steam travel.
- Lower pressure drop and higher vacuum.
- "Zero" condensate temperature depression.
- DEAERATION . . . 0.01 cc per liter is attainable.
- Purity of condensate.

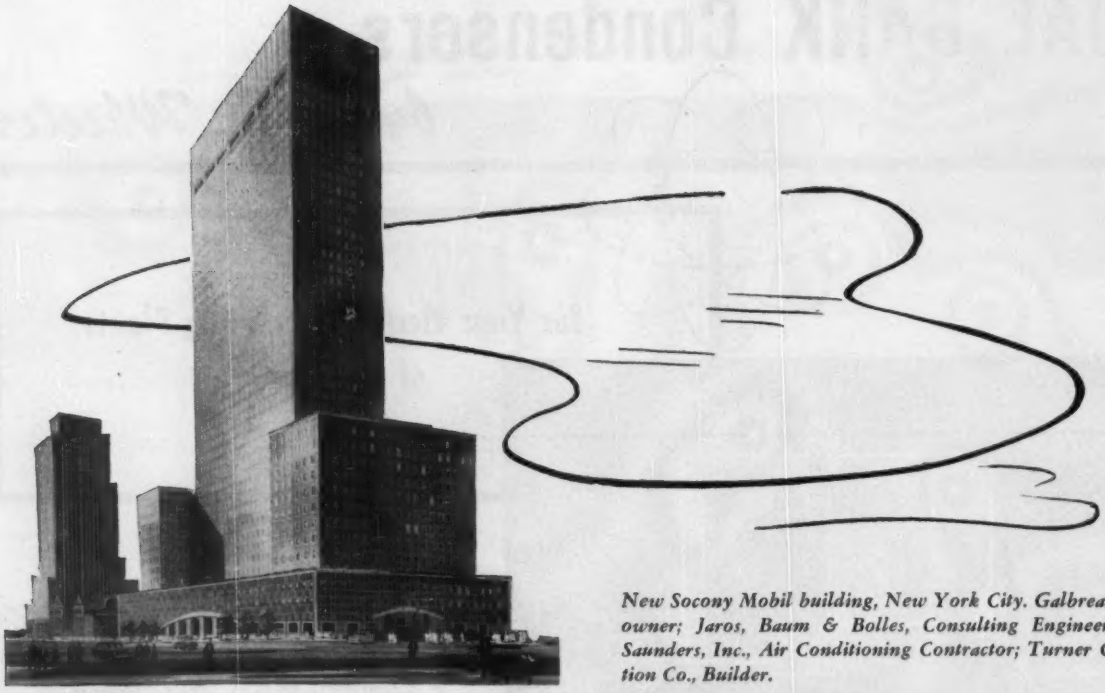
At C. H. Wheeler the most modern engineering techniques are at your service. Let our engineers help you. Contact your local representative or

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PA.

Manufacturers also of Vacuum Equipment • Pumps for Circulating Water, Condensate, Water Supply and Drainage Marine Auxiliary Machinery • Special Products for Atomic Service

WE 607

C.H. Wheeler OF PHILADELPHIA

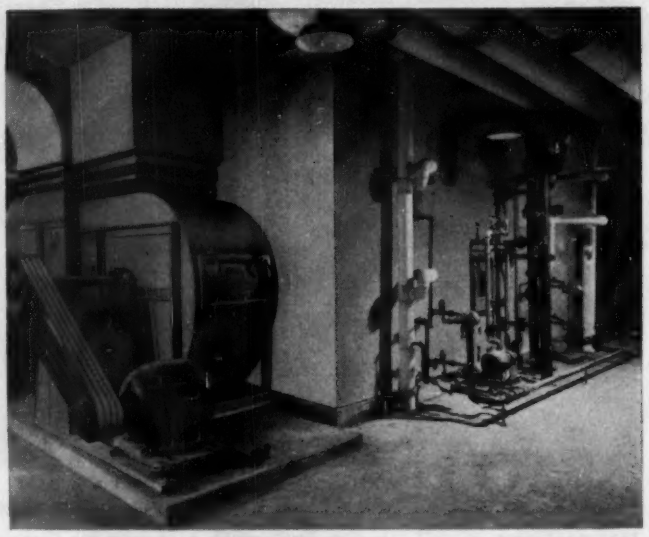


New Socony Mobil building, New York City. Galbreath Corp., owner; Jaros, Baum & Bolles, Consulting Engineer; Kerby Saunders, Inc., Air Conditioning Contractor; Turner Construction Co., Builder.

WORLD'S LARGEST AIR CONDITIONED COMMERCIAL OFFICE BUILDING USES 75 FANS, 22 CONDITIONING UNITS BY "BUFFALO"

A new landmark at Lexington and 42nd St., New York, the Socony Mobil building is a model for office buildings of the future. It is the largest fully air conditioned commercial office building in the world — the largest built in New York in a quarter-century. Offering so much to tenants, it is little wonder that its 1,300,000 square feet were virtually 100% rented before completion.

Selection of "Buffalo" for all the fans and many of the conditioning units reflects the confidence which engineers, owners and contractors have placed in "Buffalo" for the past 79 years. You will find "Buffalo" air handling equipment in outstanding plants, hotels, institutions, stores and public buildings throughout this hemisphere. And everywhere, you will find it performing to satisfaction, because "Buffalo" builds the "Q" Factor* of Quality into every unit. If you have a job for air, write "Buffalo" into the plans to insure the results you want.



"Buffalo" Type BL Fans handle air in Socony Mobil building. These fans (some of them 13 feet high) plus "Buffalo" Axial Flow Fans and "Buffalo" Shortboy Ventilation Units move all the air. PCLW Dehumidifiers, Humidifiers and PC Air Conditioning Cabinets process the air for various zones.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

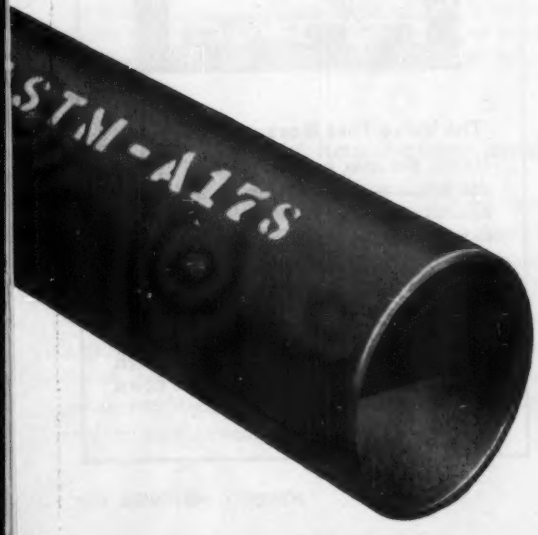
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Jones & Laughlin

Electric Resistance Welded

Pressure Tubing



QUALITY CONTROL—Jones & Laughlin, an integrated steel maker, controls every step of production from iron ore to finished tubing.

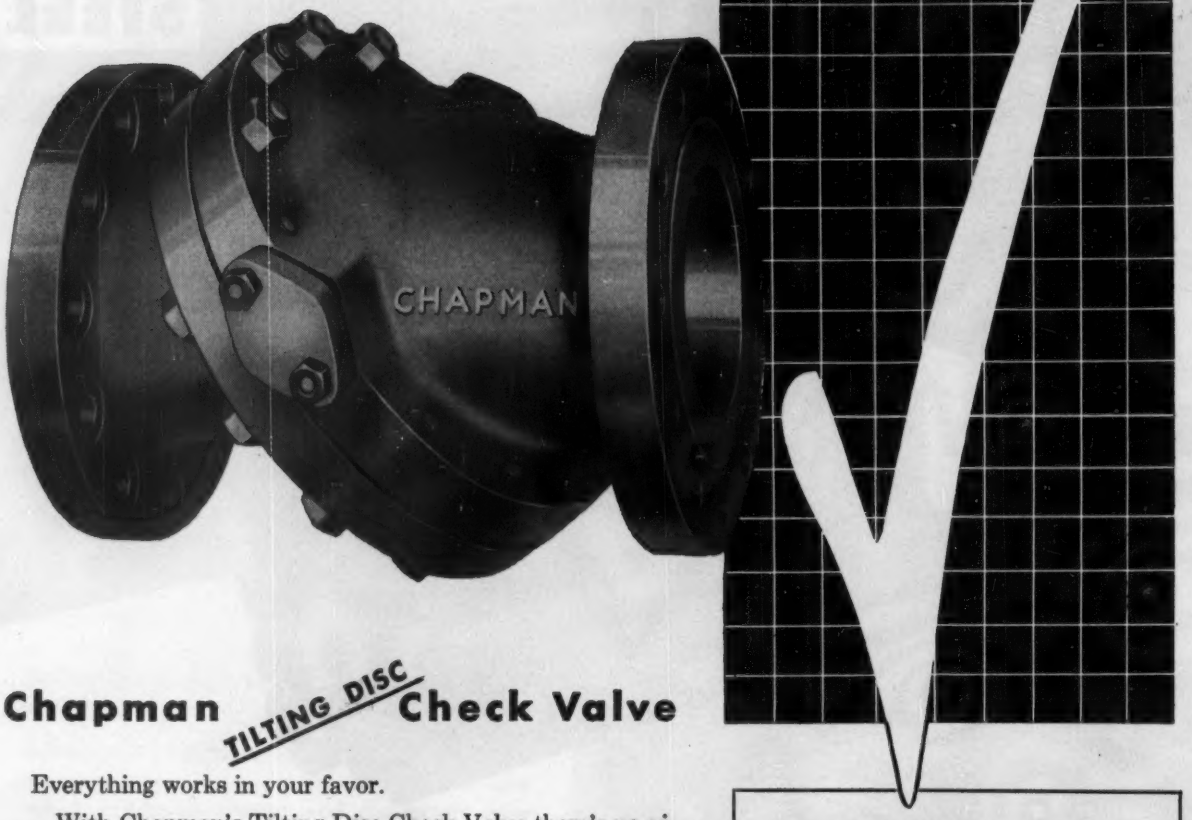
RIGID TESTING—most modern testing procedures, at every step of progress, assure maximum strength and safety standards. Users can be sure that every safeguard possible is used before a tube is certified to ASTM A178-55 or A214-55.

EASE OF FABRICATION—J&L pressure tubing can be fabricated according to your requirements.

For your next order, specify Jones & Laughlin pressure tubing for long life, maximum strength, clean appearance. Write for name of your nearest source.

Jones & Laughlin
STEEL CORPORATION · PITTSBURGH

Check This Check Valve
and keep your troubles in check



Chapman TILTING DISC **Check Valve**

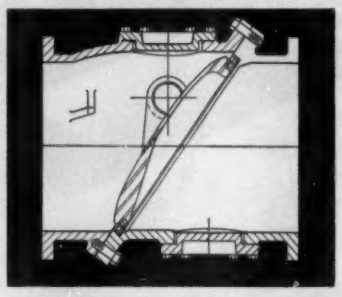
Everything works in your favor.

With Chapman's Tilting Disc Check Valve there's no vibration, no fluttering, no noise. There's no slamming, with usual piping arrangements, no banging to cause damage to system or valve. There's no grinding, scraping or wearing to either the disc or seat.

All of this means less headaches to you . . . both physical and financial headaches. The smooth, sure, quiet action means less, much less, maintenance over the longest period under toughest operating conditions.

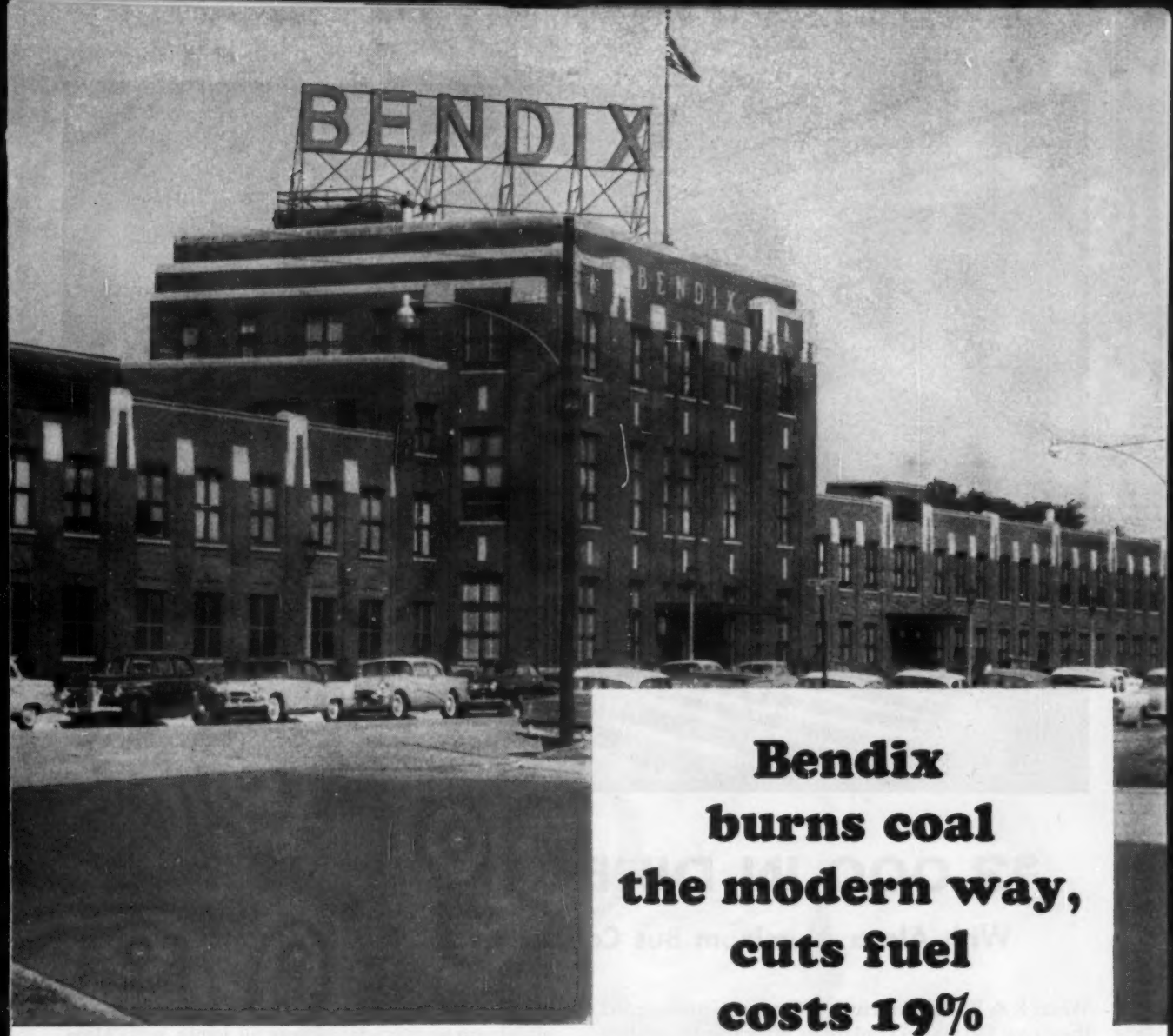
Chapman Tilting Disc Check Valves with money-saving advantages like these are available in iron and steel, with standard end to end, for handling fluids or gases under a wide range of pressures. They're listed and shown in our Catalog 30-A. Send for it and check the valves you need for replacement or new piping systems, right now.

The CHAPMAN Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS



The Valve That Goes with the Flow

Here's the idea in back of it all. When the flow is on, "airfoil" disc is held firmly against stops in the body. When the flow drops, disc balances itself quietly on whatever flow there is. When the flow stops, disc drops quickly and tightly on special bevel seat. It's as simple as that. It's as sound as that. And valve men will be pleased when they see that enough room is given around disc to cut down flow resistance.



Bendix burns coal the modern way, cuts fuel costs 19%

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

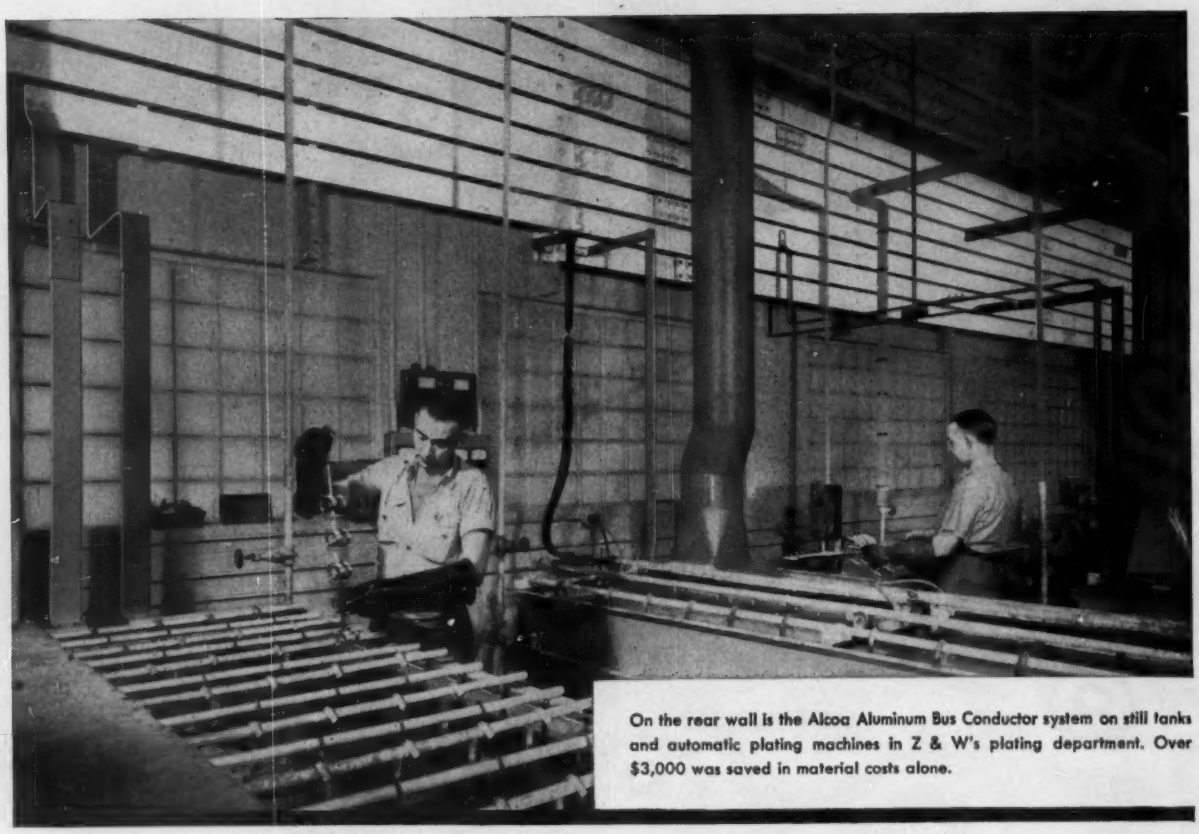
In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

At its Products Division, South Bend, Ind., Bendix Aviation Corporation undertook extensive modernization of its power system. The firm replaced two 511 HP boilers with two 80,000 lb./hr. spreader stoker fired units. A 500-ton overhead bunker and coal elevator-conveyor system were installed. Additional changes were made including an increase in the capacities of the water and air systems.

Today fuel costs at Bendix have been cut 19%, efficiency boosted from 70% to 82%, maintenance costs lowered 80% and availability upped from 50% to 96%. By burning coal the modern way, Bendix is saving many thousands of dollars yearly and will amortize the cost of modernization in a comparatively short time.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.



On the rear wall is the Alcoa Aluminum Bus Conductor system on still tanks and automatic plating machines in Z & W's plating department. Over $3,000 was saved in material costs alone.

$3,000 IN DIRECT SAVINGS

With Alcoa Aluminum Bus Conductor at Z & W Manufacturing

When Z & W Manufacturing Corporation designed their new 130,000 sq ft plant in Wickliffe, Ohio, they wanted equipment second to none—yet costs were closely watched. One of the best of the money-saving acts took place in their plating department.

After a detailed study, they used Alcoa® Aluminum Bus Conductor to carry the 12,000-amp load from individual rectifiers to the six plating lines. Compared to a copper system Z & W got the same conductivity from half as many pounds of metal. Only difference was a slight increase in size. In installing a system using high-conductivity aluminum alloy, Z & W estimates they saved more than $3,000 in direct material costs alone.

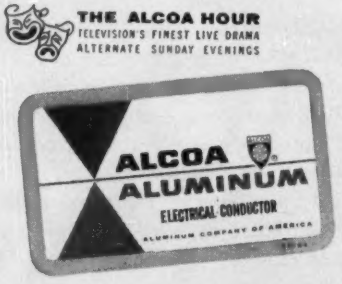
Easy fabrication and installation

Other important benefits and savings resulted from aluminum's light weight and easy handling. Also important was the ease of fabrication during their bending and drilling operations. The ½" x 6" bars were just bolted to 2 x 8's attached to the wall. Simple insulating washers and wood spacers were used.

Having some small copper bar stock on hand, they used that as leads in some places—other leads were aluminum. Trouble-free joints between copper and aluminum were made, as were all joints, with Alcoa Electrical Joint Compound and aluminum bolts.

Saves 50% on bus conductor

The same technical advice and assistance from Alcoa that enabled Z & W to engineer, design, fabricate and install this bus system are yours for the asking. Study how much you could save with Alcoa Bus Conductor—for expansion or modernization. Cost is about half. Just check the Yellow Pages of your phone book under "Aluminum" for Alcoa's nearest office. Or write, Aluminum Company of America, 2312-L Alcoa Building, Pittsburgh 19, Pa.



THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

Your Guide to the Best in Aluminum Value

Guaranteed TO SHUT TIGHT*

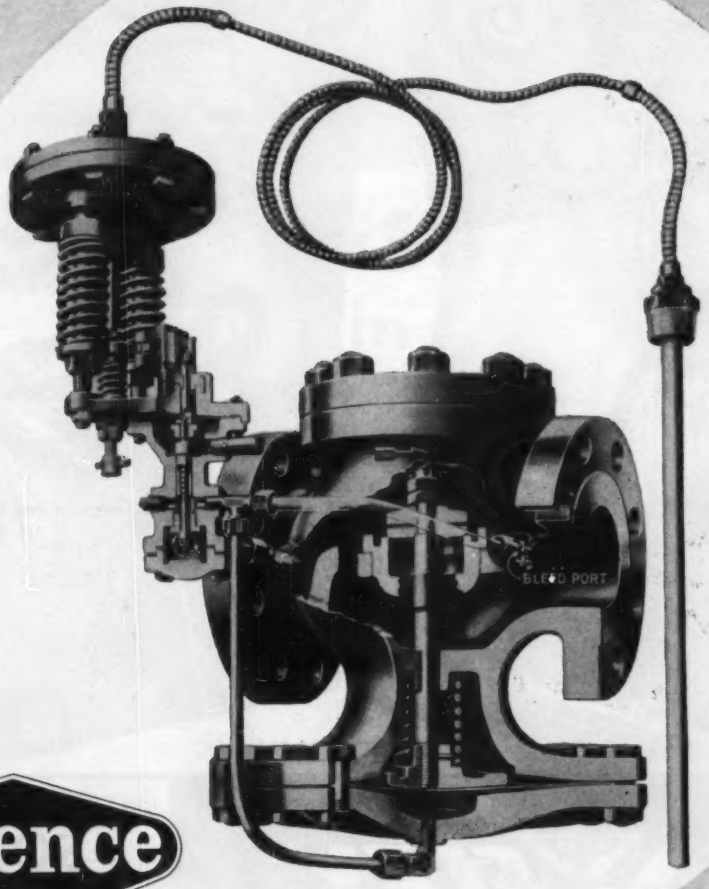
*When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

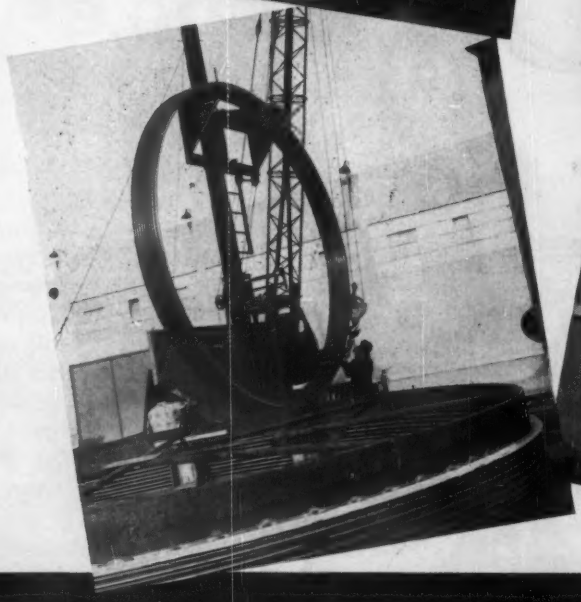


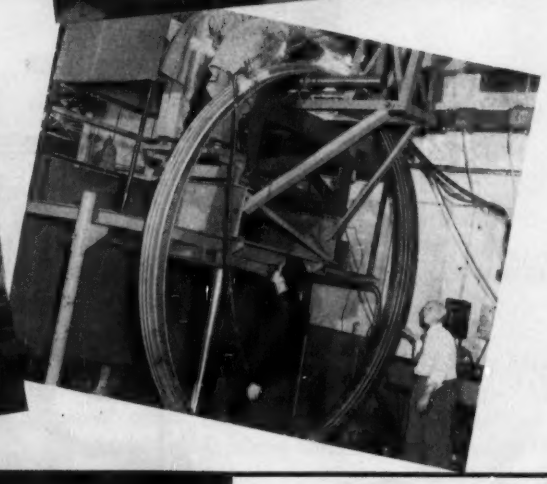
SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

BE 189





Highest quality expansion joints

Quality is built into every Sola-Flex joint. From extensive research and development programs through to precision fabrication, every step guarantees an extra measure of durability and trouble-free service. And Sola-Flex joints are economical—in initial cost and in long life. Send for a Sola-Flex catalog. Dept. C-92, Solar Aircraft Co. San Diego 12, Calif.

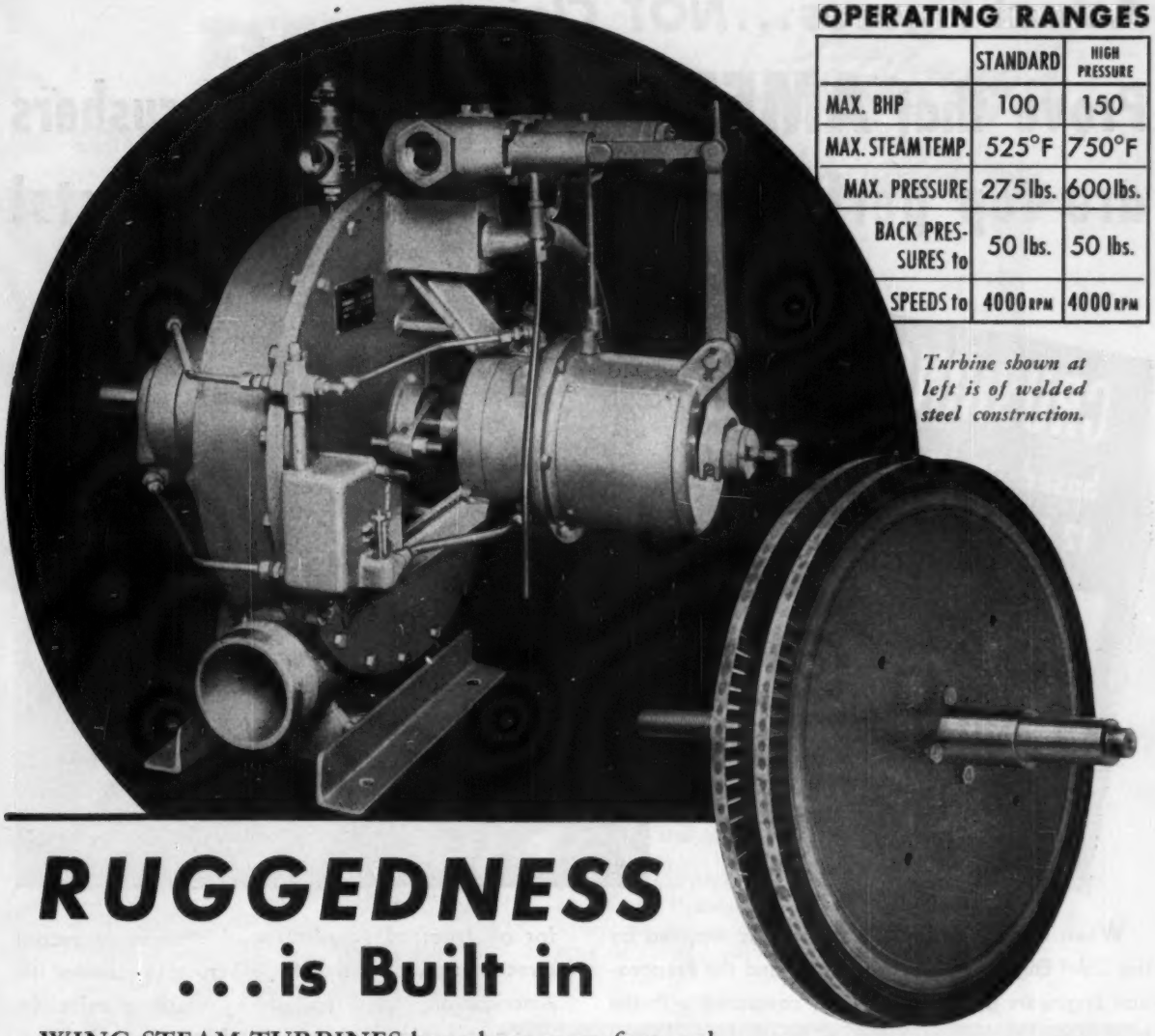
SOLA FLEX®

EXPANSION JOINTS AND BELLOWS

SOLAR

AIRCRAFT COMPANY

SAN DIEGO DES MOINES



OPERATING RANGES

	STANDARD	HIGH PRESSURE
MAX. BHP	100	150
MAX. STEAM TEMP.	525°F	750°F
MAX. PRESSURE	275 lbs.	600 lbs.
BACK PRESSURES to	50 lbs.	50 lbs.
SPEEDS to	4000 RPM	4000 RPM

Turbine shown at left is of welded steel construction.

RUGGEDNESS ...is Built in

WING STEAM TURBINES have been manufactured by L. J. Wing Mfg. Co. for nearly half-a-century. During that time these sturdy, dependable prime movers have been giving excellent service in thousands of industrial and marine installations under the most exacting conditions of operation. They are ideal for operating compressors, generators, fans, mixers and many other types of equipment. Reliability is inherent. Use the coupon to get further details.

The all-steel rotors of Wing turbines are designed for safety under all conditions. Buckets are precision welded to the periphery and capped by a steel shroud, also welded.

L. J. Wing Mfg. Co. 50 Vreeland Mills Rd., Linden, N. J.
Factories: Linden, N.J. and Montreal, Canada

Wing
AUXILIARY TURBINES

L. J. Wing Mfg. Co. P-11
50 Vreeland Mills Rd., Linden, N. J.

Please send copy of Auxiliary Turbine Bulletin T-54

Name.....
Firm.....
Address.....
City..... Zone.... State.....

Actual Figures... *NOT Claims*

Prove that AMERICAN "WC" coal crushers are top performers at low operating costs!

CRUSHING FACTS
based on User-Reports from
12 Power Plants & Coal Mines

Total Tonnage Crushed:
1,507,827 tons
Parts Replacement Cost:
$0.0028 per ton

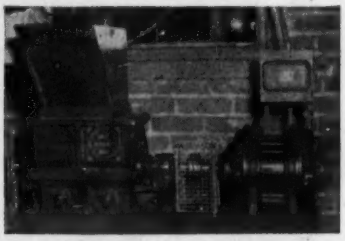
When the actual tonnage figures (as supplied by the Chief Engineers of power plants and the Preparation Engineers of coal mines) are compared with the total cost of replacement parts ordered, the real story of the quality and efficiency of American "WC" Coal Crushers is apparent—the story given in the panel above.

With American, quality is not a mere claim, nor even an isolated performance story. It is based on the consistent pattern of high-tonnage-at-low-maintenance for *all types* of American coal crushers—a record directly traceable to the efficient crushing action of the American-originated rolling-ring crushing principle, plus a half century of specialized experience in building coal crushers.

American "WC's" are designed for capacities up to 90 tons per hour . . . but whether your requirements range from coal sampling up to 600 tons or more per hour, American has the crusher to handle your job at the lowest possible cost.

. . . and for low-cost coal sample crushing

Model 9-9 American Laboratory Crusher, one of several sizes for reducing coal samples prior to analysis.



American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

TESTING and INSPECTION at Pittsburgh Piping

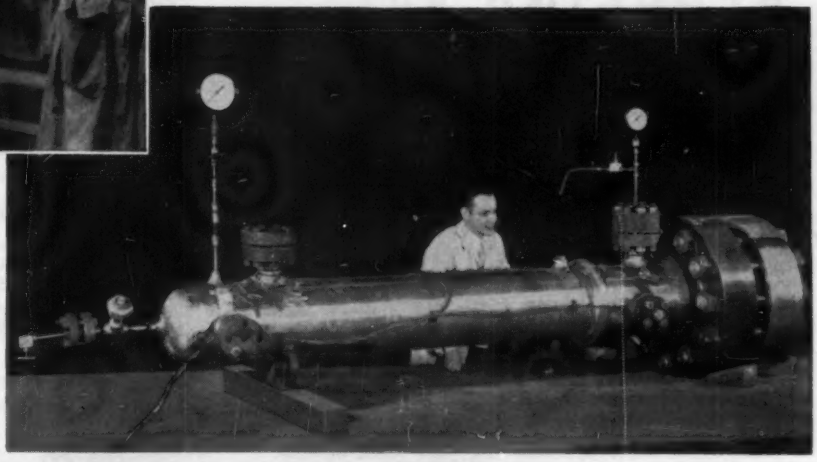
Fluorescent-penetrant examination detects surface defects. Pipe exterior is painted with fluorescent-fluid, then dusted with powder which draws fluid to surface where it is observed under ultra-violet light.

another
P. P. & E. service
which contributes to
Improved
HIGH-TEMPERATURE
HIGH-PRESSURE
PIPING

Fabricated chrome-moly header for central station piping system.

This testing instrument transmits ultra-sonic waves into pipe wall, with their movement around the pipe being indicated as a consistent pattern on the instrument's screen. Any internal defect in the pipe wall reflects the waves back to the instrument more quickly and is thereby revealed on the screen.

Close quality control is maintained throughout the fabricating process at Pittsburgh Piping by means of almost a score of different types of tests and examinations — three of which are shown on this page. Our technical staff supervises these procedures — checks all materials and production operations. This activity assures that each component, assembly, and the final piping system fabricated and erected by Pittsburgh Piping meets code and insurance requirements . . . fills the customer's specifications . . . and gives trouble-free service.



Hydrostatic testing at Pittsburgh Piping. This stainless steel surge tank is being tested at pressure up to 5,600 psi. Strain gauges are used to check closely for plastic deformation.

PRODUCTS AND SERVICES

Carbon Steel Piping	Forged Piping Materials
Cast Iron Fittings	Headers
Cast Steel Fittings	Manifolds
Chrome-Moly Piping	Pipe Bends
Copper Piping	Stainless Steel Piping
Corrugated Piping	Van Stoning
Creased Bends	Welded Assemblies
Expansion Bends	Welded Stainless Steel Tubing
Flanges	Welding Fittings

FP-23

Pittsburgh Piping
AND EQUIPMENT COMPANY
158 49th Street — Pittsburgh, Penna.
CANADA: CANADIAN PITTSBURGH PIPING, LTD.
835 BEACH ROAD—HAMILTON, ONTARIO

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street

so Halstead & Mitchell engineers said...

"THIS HAS A BEARING ON COOLING TOWER PERFORMANCE"

AT LEADING WHOLESALERS EVERYWHERE

Write for Bulletin CT-584

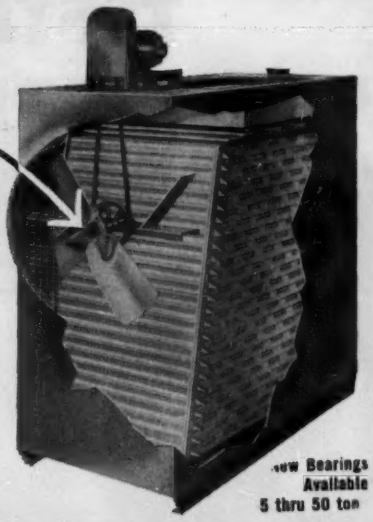
Nothing has more of a bearing on cooling tower performance and life than do tower fan bearings. On them turn *the only moving parts* in an induced draft cooling tower.

Announcement by Halstead & Mitchell engineers of a *permanently* sealed and lubricated fan bearing means a lifetime of continued high cooling tower efficiency. The complete elimination of periodic greasing means a drastic reduction in your tower maintenance costs.

With not one bearing failure reported from hundreds of towers now in use, this advance gives you, more than ever, the best buy in cooling towers on the market today.

HM Halstead & Mitchell

BESSEMER BLDG., PITTSBURGH 22, PA.

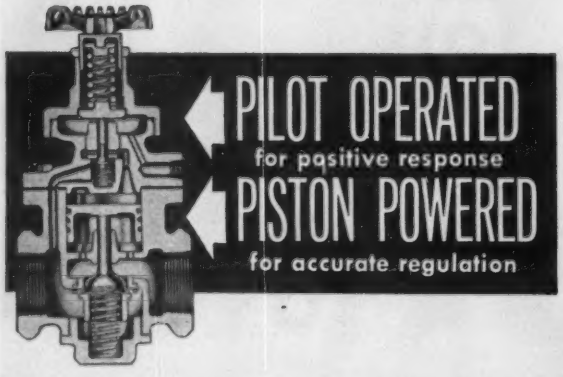


...ew Bearings Available 5 thru 50 ton

20-Year Guarantee!

on the wetted deck surface against rotting or fungus attack is an extra given you only by Halstead & Mitchell. Combined with the H & M *Protected* Steel concept, it offers unsurpassed protection against water and weather.

You can install and forget this ...self-contained pressure REDUCING VALVE



Kieley & Mueller Type 481 Reducing Valve offers really trouble-free operation on your most difficult steam regulation services . . . yet it is sufficiently low in cost to warrant use for ALL your needs.

Designed for initial steam pressure of 250 lbs. or less, Type 481 has stainless steel spring and pilot, stainless steel trim. Available with screwed connections, ½" to 2".

Send for Bulletin 4000

KIELEY AND MUELLER, Inc.

pioneer in steam specialties

64 GENUNG STREET, MIDDLETOWN, NEW YORK

HOW THIS EMERGENCY LIGHTING UNIT CUTS MAINTENANCE COSTS

LIGHT WARDEN CHARGOMATIC 88

1. Guaranteed *5 years*—both battery and unit.
2. Eliminates manually operated charger switches and timers.
3. Eliminates undercharged and overcharged batteries, cutting maintenance costs to the minimum.
4. Eliminates meters and messy hydrometers.
5. One standard unit can support 5 heads mounted remotely as desired.
6. Needs addition of water only once in 6 months.
7. Completely automatic operation assures unfailing protection.

Complete engineering service available. Recommendations and quotations gladly furnished. Catalog on request.

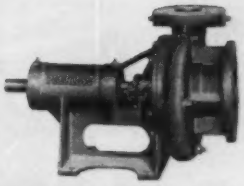
ELECTRIC CORD COMPANY

195-D WILLIAM ST., NEW YORK 7, N. Y.

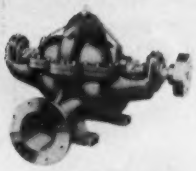
How to Save

TIME \ MONEY \ ENERGY

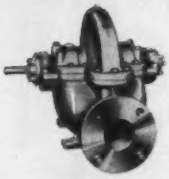
TYPE PE FLUIDYNE INTEGRAL HP PUMPS
A complete line of electric close-coupled general purpose pumps. Threaded or flanged connections. Capacities: to 800 gpm; heads: up to 260 feet; motors: up to 50 h.p.



TYPE PB FLUIDYNE GENERAL PURPOSE PUMPS
Flexible coupled, single-stage, end suction, general purpose pumps. Rugged and durable. Capacities: up to 5500 gpm; heads: up to 260 feet; motor: up to 150 h.p.



TYPE A GENERAL PURPOSE PUMPS
For application to the widest variety of pumping conditions. Single stage split case design. Capacities: up to 70,000 gpm; heads: to 300 feet. All types of drive.



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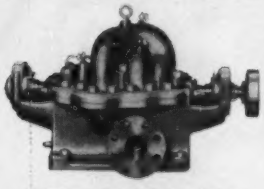

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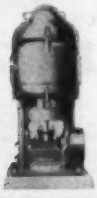

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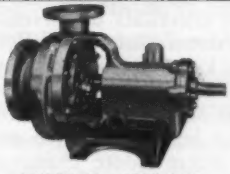

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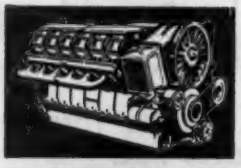

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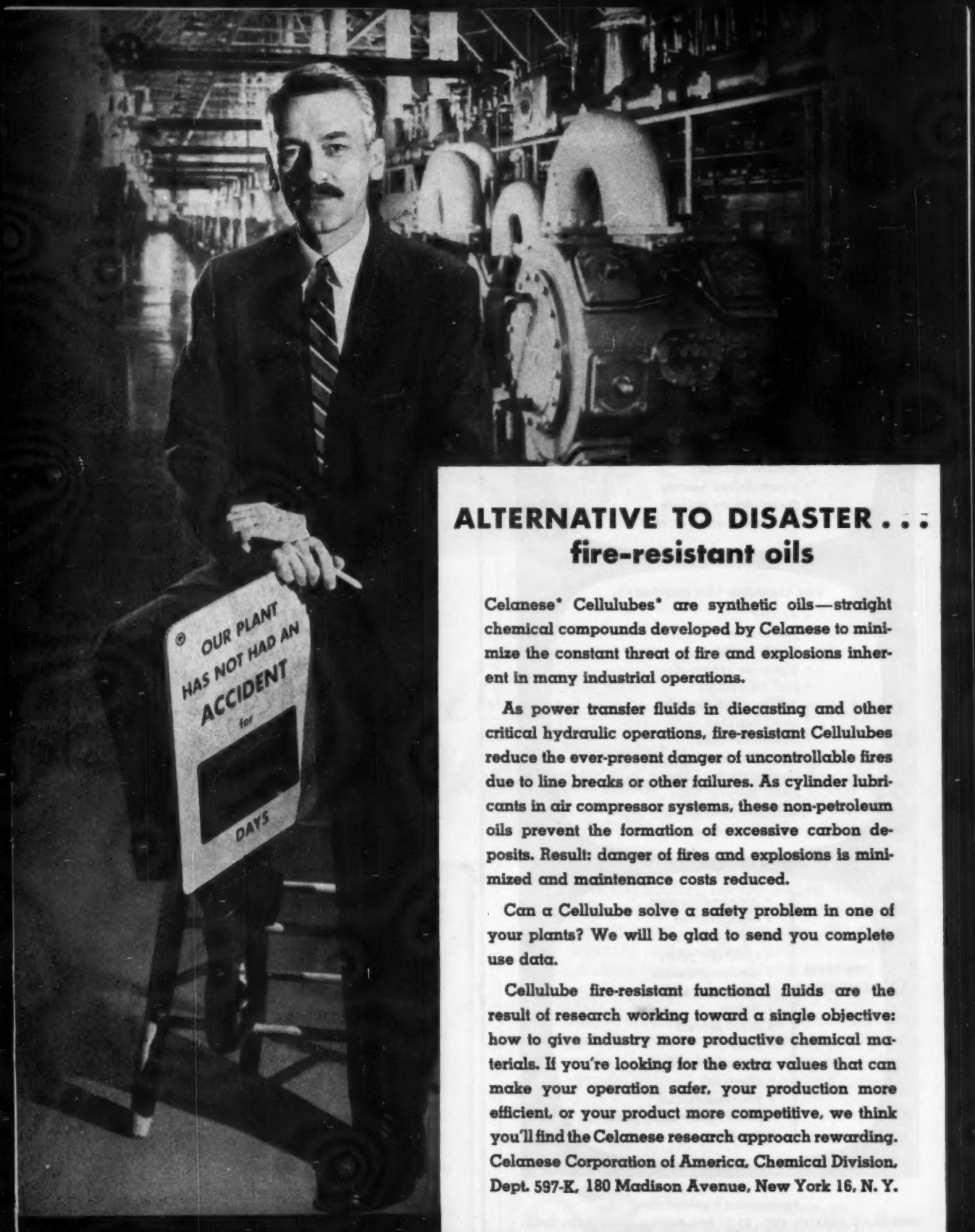

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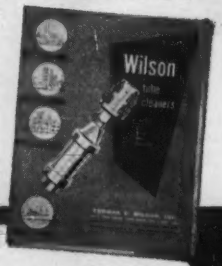

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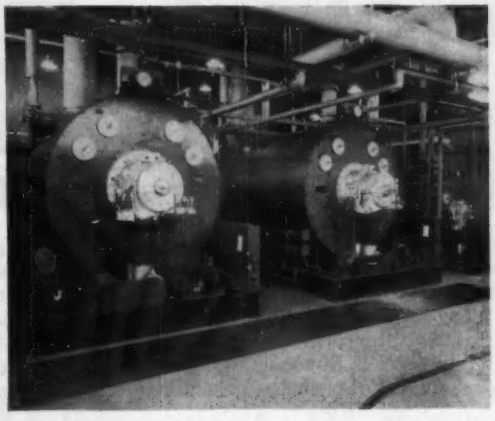

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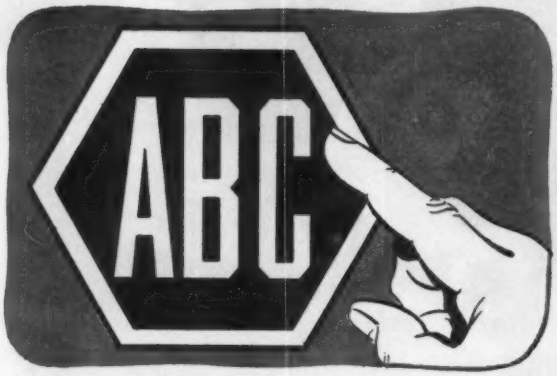

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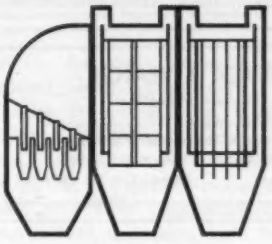

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5-10 years transmission & distribution experience. Knowledge overhead systems, material equipment in overhead lines construction. Also short circuit calculations on their systems.

Positions are permanent with ample opportunity for advancement in position and earnings.

Liberal company benefits

Send detailed resume and salary requirements to Corporate Personnel Dept.

AMERICAN and FOREIGN POWER COMPANY, INC.

2 Rector Street, New York 6, New York
Personnel Dept. DI 4-4400 14th Floor

SR. ELECTRICAL ENGINEER

Foreign Employment

For responsible staff position which involves planning and staff engineering of new electrical power generation plants utilizing steam or gas combustion turbines and related facilities for major oil installation in Saudi Arabia.

Must be a graduate electrical engineer with proven supervisory ability with minimum ten years' experience in planning, design and study of utilities systems, power generation, transmission, distribution and related work. Minimum salary $1000 monthly plus allowances and generous benefits.

Write outlining personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 181

ARABIAN AMERICAN OIL COMPANY

505 PARK AVENUE
NEW YORK 22, NEW YORK

MECHANICAL ENGINEER—POWER

Recent graduate, veteran, to understudy plant engineer, national chemical company. Indianapolis location. Salary to $550 month start. Write age, education, experience.

P-3095, POWER
Classified Adv. Div., P.O. Box 12, N. Y. 36, N. Y.

REPLIES (Box No.): Address to office nearest you c/o this publication. Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

Wanted—Man to take charge of diesel-powered electric generating plant. Location Mid West town of 2000. Write to P-2850, Power.

SELLING OPPORTUNITIES OFFERED

Manufacturer of surface condensers, feedwater heaters, oil heaters & coolers and pressure vessels, located in New Jersey, requires additional sales representatives. Contracts in Power and Industrial Plants desirable. RW-1953, Power.

European manufacturer of exceptionally efficient high pressure packaged steam generators, from 15 to 500 HP, offers U.S. license. Can supply highly developed technical assistance. Write Leon G. Rucquoi, 30 Rockefeller Plaza, New York 20, N. Y.

POSITIONS WANTED

Power engineer, 32, technical and college training, 12 years experience in all types steam electric generation, wishes to relocate in Middle Atlantic States. PW-2895, Power.

Power Engineer—eleven years experienced in operation and maintenance of modern hi-pressure central stations and industrial power plants. Thirty-seven years old, married, seeks responsible position in domestic or foreign service. Presently located in South America, will be available in sixty days. PW-2935, Power.

SELLING OPPORTUNITIES WANTED

Established sales representative (three men), metropolitan New York City area desires additional line, preferably for industrial and, or, utility boilers. RA-2590, Power.

Established sales agency desires additional mechanical equipment lines. Extensive following in utilities, automotive, chemical, and industrial plants in Michigan and Toledo, Ohio area. RA-3185, Power.

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Power published Monthly at New York, N. Y. for October 1, 1956.

1. The name and address of the publisher, editor, managing editor, and business manager is: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York 36, N. Y.; Editor, L. N. Bowley, 330 West 42nd Street, New York 36, N. Y.; Managing editor, J. J. O'Connor, 330 West 42nd Street, New York 36, N. Y.; Business manager, George A. Keates, 330 West 42nd Street, New York 36, N. Y.

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[SEAL] JANET A. HARTWICK
(My commission expires March 30, 1957)

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You'll enjoy it. 4th Ed. Send $2.00 to

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Turbine suitable for 400 psig 700 deg. total temperature, extraction 16,000 pounds per hour minimum at 150 psig. final exhaust at 5 psig. As an alternate, this machine may be condensing with two extraction points of 150 and 5 psig. Electrical characteristics 480 volts 3 phase 60 cycles.

Address all proposals to

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WANTED

B&W boilers sectional header type. Also fire tube boilers. Write to:

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Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers or Complete Power plants.

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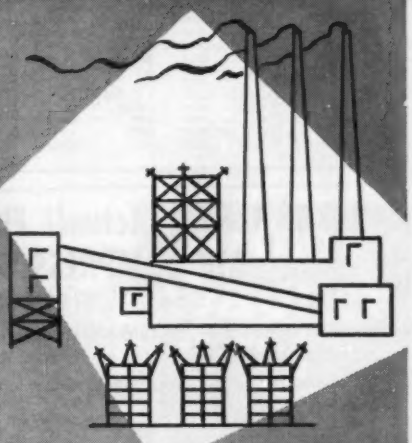

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HI-PRESSURE
Complete stock from 10-2,000 h.p.
Nation's largest inventory. New & Used.
WABASH POWER EQUIPMENT
31 E. CONGRESS, CHICAGO 5, HA 7-4855

COMPLETE SWITCHBOARD
DESIGN & CONSTRUCTION
USED & REBUILT EQUIPMENT
DIESEL SALES & SERVICE
GENERATORS—GAS OR DIESEL
UNIVERSAL POWER ENGINEERING CO.
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Phone: DElaware 2-8300

SAWMILL POWER PLANT • *ultra-modern throughout*

Each piece is a super-value . . . part of the top-quality equipment of Fischer Lumber Co., the West's Most Modern Sawmill . . . now liquidating—now offering you these tremendous values!

- 2—375 HP Garrett & Shafer Boilers 300 lbs.; Super Heaters 700° total.
- Dutch Ovens for Firing Hogged Fuel and Shavings—also Oil.
- Water Walls and Bigelow-Liptak Suspended Wall and Arch Settings.
- Forced and Induced Draft.
- Fly Ash Corp. Dust Collectors; Fisher Governor Controls and Reducing Valves; Permutit Deaerating Heater; GE Turbine Drive on an Ingersoll-Rand Boiler Feed Pump; GE 2,000 KW Alternating Current Generator, 480 Volts; GE Latest Synchroscope and Switch Gear.

Contact:

FISCHER MARCOLA LBR. CO. 858 Pearl St., Eugene, Ore. • Ph. Diamond 5-8533

Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	H	1	4600-120/240
1	750	G.E.	HT	3	4150Y-220/440
2	250	G.E.	H Pyranol	1	2400-4800/8320Y-120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H-KD	1	13800/12420/4000-240/480
3	200	G.E.	H	1	7800/15600-220/440
1	150	Elsler	OA	1	4160-240/480
3	150	West.	S	1	2400/4160-460/230/115
3	50	G.E.	HS	1	2400/4160-240/480
2	37½	West.	Hyperail	1	2400/4160-240/480
1	25	G.E.	H Pyranol	1	2400/4160Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	300		2200
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY RW	230
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	230
1	500	G.E.	1200	M	2400/415

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	75	G.E.	1800	K-4458	440
1	100	West.	1160	CS	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1700	K.-T E.F.C.	2300
1	275	G.E.	1200	KT559BS	2200
2	300	G.E.	1800	K-4150	new

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	Volts AC
1	30	G.E.	1800	125	220/440 Y.
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1800	250	480 v. S.C.
1	150	CR. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	30	G.E.	1650/1800	CDM 85
3	30	C.W.	700	CM
1	35	G.E.	860	RC
1	75	C.W.	900	WP
1	125	G.E.	1700	RC
2	150	C.W.	900	WP
1	250	Allis Ch.	1750	EBL149 BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	565	440
2	300	G.E.	ITV-5617	600	440

FOR POWER
J. L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK: JONQUIL 5-[illegible]

COMPRESSOR DIRECTORY
World's Best Rebuilts

95 CFM	1500 PSI	6½-3⅞x1⅝x7	Chicago TCB3
138 CFM	100 PSI	7x7	Ingersoll ESI
203 CFM	300 PSI	9-4¾x5	Penn AT2
234 CFM	100 PSI	9x9x9	Chicago St. (new)
268 CFM	500 PSI	10-4½x10	Ingersoll XOB
343 CFM	500 PSI	11-5x13	Worth. (new frame)
464 CFM	100 PSI	12x11	Gardner RX
552 CFM	100 PSI	13-8"12	Ingersoll XRB
502 CFM	125 PSI	12x13	Chic T
545 CFM	100 PSI		Allis Chal. Rotary (2)
676 CFM	100 PSI	15-9½x12	Ingersoll XRB
782 CFM	100 PSI	15½-9x10	Chic OCE Syn
1600 CFM	40 PSI		Fuller Rotary—Syn.
1723 CFM	110 PSI	140 lbs. st	Ingersoll XPV

Portables—Worthington 60 to 600 CFM

American
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N. J.
Telephone UNion 5-4844

FOR SALE
DIESEL GENERATOR

General Motors 8-268A engine direct connected to 2000 Amp. 180 volt D.C. Generator. This unit has been thoroughly rebuilt and is equal to new. Will sell complete unit or diesel engine alone.

ARDEN CHEMICAL CO., INC.
548 Messrole St., Bklyn, N. Y. HY 7-2550

2–768 C.F.M. *(Actual)* FULLER 2-STAGE ROTARY AIR COMPRESSORS – NEW 1953

Size C-150-150H 100 lbs. pressure

Direct Synchronous Motor Driven with regulators, intercoolers, air-maze filter, silencer, Manzel mechanical lubricators, aftercoolers, essential piping, valves, air receiver.

Motor Control: GE Limitamp Synchronous motor starters, 400 amp ITE 5 KV interruptive switch.

IMMEDIATE SHIPMENT

L. J. LAND, INC.

144 Grand St. Phone CAnal 6-6976 New York 13, N. Y.

FOR SALE

Riley Steam generating Boiler
1700 H.P.—60,000 lb. per hr. water tube boiler
5300 Sq. ft. heating surface
1600 sq. ft. water wall surface
353 # pressure—arranged for coal oil or gas
Completely equipped with blowers, fans, turbines, controls, dust collector.
Replacement cost approximately $400,000.00
Open for offer—for immediate delivery

For further information — contact

M. J. ANDERSON

Crosby Bldg., Mohawk 2050, Buffalo, N. Y.

–TRANSFORMERS–

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.

5318 Hetzel St. Cincinnati 27, Ohio

40 Years' Dependable Service

BARGAIN TRANSFORMERS

2—600 KVA, General Electric, 3 ph, 60 cy. 6900/11950Y/13800 x 230/460 volts

3—500 KVA, Westgh. 2400 x 480 volts

6—250 KVA, Westgh. 2400 x 240/120 volts

Send for new list just issued. What have you for sale in electrical equipment?

KEYSTONE POWER PLANT EQUIP. CO.
8403 Hegerman St., Philadelphia 36, Pa.

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION

Send for new list

EBASCO SERVICES INCORPORATED

APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

FOR SALE
MODERN POWER PLANT

2500 KVA GE Turbine Generator 3/60-2300/4160 volt, 400# 750° FTT, complete with boiler, superheater, economizer, condenser, boiler feed pump, feed water heater Hagan Combustion Control.

ELECTRIC EQUIP. & ENGR. CO.
Box 6597 Denver 16, Colo.

500 HP PACKAGE BOILERS

5—Ames Iron Works, High Pressure Steam Generators, 500 HP, 125 psi, oil fired for #6 oil. Capacity 17250# steam per hour, 16800 BTU, 70,000 sq. ft. EDR rating; ASME U69 constructed, National Board Registered. Built 1953.

R. GELB & SONS, INC.

US 22, UNION, N. J. Murdock 6-4900

ERIE CITY BOILER

200 HP Type VL package type water tube boiler. Will develop continuously 425 HP or 14,000 lbs. steam per hr. Set pressure 125 lbs. per sq. in. rated 160 lbs. per sq. in. Complete with all trim, underfeed coal stoker, induced draft fan, automatic controls and stack. New in 1951.

COVERALL SERVICE & SUPPLY INC.
551 Smith Street, Buffalo 10, New York

FOR SALE
1875 KW MOTOR GENERATOR SET

1875 KW General Electric generator, 250 volts direct current, direct connected 2600 HP General Electric synchronous motor, 3 phase, 60 cycle, 11,000 volts, 600 RPM, complete with automatic switchgear. Excellent condition.

INTERNATIONAL POWER MACHINERY CO.
1610 Union Commerce Bldg., Cleveland 14, Ohio

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT SELECTED STOCK ITEMS

RE-NU-BILT—GUARANTEED—RE-NU-BILT

COMBINATION MILL DRIVES — 15/2500 HP

D.C. MOTORS WITH M.G. SETS & CONTROLS

Qu.		MAKE	TYPE	VOLTS	R.P.M.
1—	2200 HP	G.E.	MCF-12	600	400/500
	2200 KW	G.E.	Syn.	2300/4000	514
1—	1250 HP	G.E.	MCF	600	600/750
	1000 KW	G.E.	Syn.	2300/4600	720
1—	1000 HP	G.E.	MCF-8	600	350/700
	1000 KW	G.E.	Syn.	2300/4160	720
1—	200 HP	G.E.	CD-16502	250	500/1500
	200 KW	Whse.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
2	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6600	257
1	1500	G.E.	MT	6900	1187
1	1100	F.M.BB	SF8068	4800/2400	1800
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	150	Whse.	CW30E17	2300	435
2	125	A.C.	ANY	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
2	650	G.E.	FT-559BY	440	3570
2	450	Whse.	CS-1420	2300/4150	554
1	400	G.E.	IE-15B	2300	1165
1	400	G.E.	IK	2200	500
1	200	G.E.	IK-17	440	580
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900
3	2000	Whse.		2300	120
1	1100	G.E.	ATI	2300/4600	900
1	500	G.E.	TS-7567	2200	1200
1	450	Whse.		2200	450

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
1	3000(3U)	G.E.	514	600	4000/6600/13200
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500-25cy	600	11000
2	2000	G.E.	514	600	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1250	Whse.	720	600	2300
1	1000	G.E.	900	250	6600
1	750	Whse.	900	250	2300/4150
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
1	150	Whse.	1200	600	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva 0.7 p.f.—2300/4600 V. 3/60 Generator with 1750 Kva—.8 p.f.—2300 V. 3/60 motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltage
1	3000	A.C.	OISC	3	33000x2400/4160
1	2500	Al.Ch.	OISC	3	34500x13800
1	2500	Al.Ch.	Fur.	3	13800x147/113
3	500	G.E.	HD	1	4800/2400/480
3	500	Kuhl	OISC	1	13800x6900
3	333	G.E.	HS	1	7200x2400x4160Y
1	300	G.E.	OISC	3	4160/480/270Y
3	250	L.M.	OISC	1	14400/13800/240/120
3	200	Whse.	OISC	1	13200x120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 660° F.T.T. 60 lb. extraction 3/60/240 V. Div. Conn. Exc.
1	1000	Moore	Auto-Ext. Cond 175200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 430/3/60.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

Thousands of Motors & Generators IN STOCK.

EVERY MACHINE COVERED BY THE WAGNER GUARANTEE

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
200	Reliance	1400-T	230	850
175	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1600
100	Reliance	651-T	230	575/1150
75	F. Morse b.b.	DH-140	115	1600
75	G.E. b.b.	CD-173	230	300/1200
60	Allis Ch.	E-146	230	1150
50	G.E. (3)	CD-125	230	400/1200
50	G.E. b.b.	CD-93		2500
40	Reliance b.b.	131-T	550	1750
30	Imperial b.b.	D-69	230	400/1600

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
300	Gen. Elec.	2200/440 AC	260 DC
250	Allis Ch.	2200/440 AC	350 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	G.E. converter	440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	125/250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	G.E. (2)	CY-275	260	1200
250	Allis Ch. b.b.	EW	350	1200
200	Reliance	1400-T	250	1200
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
100	Whse.	SK-180	250	900
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Whse. b.b.	SK-163	125	1000
60	Allis Ch. (3)	E-146	250	1500
40	Gen. Elec.	RC	250	1750

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	G.E.	Slipring	220/440	1800
700	Allis Ch.	Sq. Cage	440	900
600	G.E.	Slipring	2300	600
500	Whse.	Slipring	2200	450
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	480	400
400	Whse. (3)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2300	3600
400	Whse.	Sq. Cage	2200/440	1200
350	G.E.	Sq. Cage	2200	1800
300	El. Mchy (2)	Synch.	2200/440	360
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
300	Allis Ch.	Sq. Cage	2200/440	720
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2300/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
225	G.E.	Synch.	220/440	900
200	G.E. b.b.	Sq. Cage	2200/440	1200
200	Whse. (2)	Slipring	2300	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	220/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	E.M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
150	Cr. Wheeler	Sq. Cage	220/440	450
125	Whse. TEFC	Sq. Cage	2200/440	720
125	Gen. Elec.	Slipring	440	600
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Ideal	Slipring	4000/2200	900
100	Whse. TEFC	Sq. Cage	220/440	1200
100	Whse. (2)	Sq. Cage	2200	900

Buy now from this tremendous stock of excellent machines... AC & DC... all sizes and types up to 1000 H.P.

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500/550 VOLT DC MOTORS

1—60 HP Westinghouse, CP. WD., Type SK 550 Volt DC, varying speed, 1150 RPM
1—50 HP General Electric, Series WD., 600 RPM 500 Volt DC, with electric brake
1—25 HP Westinghouse, CP. WD., Type SK, 550 Volt DC, 600 RPM
1—15/25 HP General Electric, CP. WD., Type RC, 400/600 Volt DC, 1500 RPM
1—15 HP General Electric, SR. WD., Type CVC, 550 Volt, 1350 RPM

DC ARC WELDERS

(550 Volt DC Motor Driven)

1—300 Amp (30KW) General Electric, CP. WD., Type RMC-12, 60 Volts DC, Driven by 45 HP General Electric Motor, SH. WD., Type RC-33 550 Volt DC, 1200 RPM
2—300 Amp Westinghouse, Type SCF, 40 Volts DC, 1500/1900 RPM, Motor, Westinghouse Type SK, SH. Wd., 450/650 Volts DC, 1500/1900 RPM
1—300 Amp Westinghouse, Type CF-3, 40 volts DC, 1500/1900 RPM, Motor, Westinghouse Type SK, SH. WD., 400/600 Volts DC, 1500/1900 RPM

MOTORS—SYNCHRONOUS

(3/60/2300)

1—250 HP General Electric, Type TS, Form AL, Frame 7644, RPM 720
1—250 HP General Electric, Type ATI, Form B, RPM 600
1—200 HP General Electric, Type TS, Form BL, Model 5G883, Frame 7558, RPM 900
1—150 HP General Electric, Type TS, Form BL, Model 5G323, Frame 7556, RPM 900

MOTORS—SLIPRING

2—300 HP Westinghouse, Type CW, 3/60/4000 (2300), 1760 RPM
1—250 HP General Electric, Type MT, 3/60/2200 (440), 700 RPM
1—250 HP General Electric, Type I-M, 3/60/2300, 450 RPM
2—200 HP General Electric, Type I-M, 3/60/4000 (2300/440) 1800 RPM
2—200 HP Westinghouse, Type CW, 3/60/2300 (440), 580 RPM
1—200 HP General Electric, Type I-M, 3/60/440, 450 RPM

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100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

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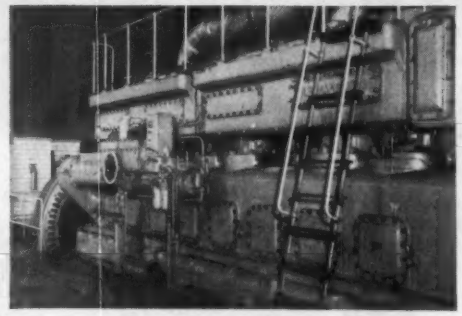
3/60/480V



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Other Sets from 20 KW to 1200 KW

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WORTHINGTON BB5 100 KW — 600 RPM 3/60/480
ENTERPRIZE DSX-26 300 KW — 720 RPM 3/60/480

NATIONAL METAL & STEEL CORP.

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Complete in every respect

1—1875-KVA., G.E., 440#, 750°FTT, 28" VACUUM, 3/60/2300-V.

Excellent Condition and Complete
Both Priced Right.

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5000 KVA TURBO GENERATOR, condensing, 450 PSI.

200 KW MG SET, 250 Volts DC, 2300/3/60, with panels.

6300 sq. ft. CONDENSER.

700 HP Ideal Synch. MOTOR 4150/2400, 514 RPM & panel.

628 CFM TYPE ES1, I.R. COMPRESSOR 100 PSI, 100 HP Motor.

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153 HP UNION WATER TUBE, 160 PSI.

250 HP B&W, 150 PSI.

4' x 135' STEEL STACKS.

70,000 LB. HEINE, 400 PSI.

80,000 LB. ERIE, 250 PSI.

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Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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408 DONOVAN BLDG.
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TURBO-GENERATORS

2500 KW G.E. Non-C. 3/60/2400/4160 V 3600 RPM 185 PSIG 30# BP

2000 KW Allis, Cond. 3/60/2400 V. 3600 RPM 400 PSIG 600# TT

1000 KW G.E. Cond. Extr. 3/60/480 V 3600 RPM 225 PSIG 20# extr.

Full line power equipment

BREW, WOLTMAN & CO., INC.

50 Church St., New York 7, New York

FOR SALE
5—OIL CIRCUIT BREAKERS

Whse. late type, outdoor type, De-Ion Grid, T.P.S.T., Rated 161000 V., 1200 amps., 60 cy., 3 ph., Type GO-3, Interr. Duty 1,500,000 KVA.

Fully complete—Cond. like new.

Price and further inf. upon request.

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Box 566 — Dalton, Pa

HYDROMATIC BRAKES

(2)—manufactured by The Parkersburg Rig And Reel Co. Type "S"—size 32"—15 PSI—720 RPM—4000 HP—5" shaft diameter.

EQUAL TO NEW—TEST RUN ONLY

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313 E. BALTIMORE STREET
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DIESEL GENERATOR SETS

2—McIntosh-Seymour (Alco) 950 HP 8 cyl. 225 RPM, 875 KVA Westinghouse 3 phase, 25 or 60 cycle alternators. 20 KW exciters.

1—McIntosh-Seymour (Alco) 600 HP 5 cyl. 225 RPM, 500 KVA General Electric 3 phase, 25 or 60 cycle alternator. 15 KW exciter.

Complete plant installation with all accessories. Priced attractively. With or without generators.

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STEAM ENGINE

1 Skinner Engine Co. (Erie, Pa.) 400 HP Skinner Universal Una-Flow horizontal single cylinder steam engine, Serial #10785, 22" dia. x 24" stroke cylinder, operating at 200 RPM on 135# steam, side crank, enclosed frame, W/O sub-base, with outboard bearing and 7' x 20" flywheel, with Skinner system of automatic lubrication, 7" throttle valve, 7" steam separator, pipe rail and wire mesh guards. First class condition. Available about Jan. 1957 subject to prior sale.

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Class. Adv. Div. P.O. Box 12, NY 36, NY

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325 H.P. sectional header, cross drum, 160# pressure, with stoker. Installed new 1945.

Special price before removal

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1620 N. Delaware Ave., Phila. 25, Pa.

Available immediately

NEW ELECTRIC MOTORS, CONTROLS, TRANSFORMERS

Cash for your surplus new motors

AJAX ELECTRIC MOTORS CO.
Phone Long Distance 132
61 Curlew St., Rochester, N. Y.

GUARANTEED REBUILT POWER EQUIPMENT

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2000	*G.E.	MT	257
1500	*Westg.	CW	600
1200	*Al.-Ch.	ANT	1800
600	*G.E.	MT	450
500	Westg.	CW	600
300	G.E.	IM-17B	600
250	*G.E.	IM	720
200	G.E.	IM	600
200	Westg. (2)	CW	514
200	*Westg.	CW-905A	514
150	Cr.-Wh.	50-R	1800
150	Westg.	CW	450
125	G.E. (2)	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	MTC-5546	900
100	G.E.	IM	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al-Ch.	ANY-26F	900
75	Al-Ch.	ARY	720
75	G.E.	MT-352	720
75	G.E.	MT-556	720
75	G.E.	IM	600
60	Al-Ch.	ARY	1200
60	G.E.	MT-546	1200
60	*G.E.	MT-536	1200
60	*Westg.	CW762C	900
50	Westg.	CW	1800
50	G.E.	IM-11A	1800
50	*Al-Ch.	ARY	1200
50	Westg.	CW936A	1200
50	*G.E.	MT-536	1200

SLIP RING MOTORS

Crane & Hoist Service
3 phase, 60 cycle, 220 or 440 volt

H.P.	MAKE	TYPE	SPEED
80	G.E.	MTC-5552	600
75	Westg.	CI-756A	600
50	Westg.	MW-334	600
50	G.E.	HIC-TENV	600
35	G.E.	MTC-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5944	900

DYNAMOMETERS

250 VOLT DC WITH PANELS AND GRID RESISTORS

H.P.	MAKE	TYPE	SPEED
125	G.E. Cradle	TLC-20	2700/6000
150(3)	G.E. Cradle	TLC-50	2500/5000
200	Westg.-Block	SK-151	1350/4000

PLATERS

AMPS.	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12—220/440
2000/1000	Chandy.	6/12—220/440
1500/750	Chandy.	12/24—220-440
1500/750	Chandy.	6/12—220/440
1000/500	Chandy.	12/24—220/440

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al-Ch (3)	ANX	3600
1200	*Al-Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al-Ch.	ARW	3600
500	*G.E.	KT568S	900
500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	Westg.	CS-8120S TEFC	1800
250	G.E. (2)	KT-559	1800
250	*L-Allis	OEX-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	KT-564	900
200	*Westg.	CS-930A	900
200	G.E. (2)	KR-564S	720
200	Al-Ch.	ARWWT	600
150	G.E.	IE-13B	1200
150	*Al-Ch.	AH-30F	1200
150	G.E.	IK-15A	900
150	*Westg.	CS	600
125	*Westg.	CS-771 Sppf	1800
125	*Al-Ch.	AR	1800
125	Westg. (2)	CS-761S	1750
125	Cr. Wh. (2)	Size 5QR	1200
125	*Reliance	AA 6085	900
125	Al. Chal.	AN	514
100	Westg.	CS 5075 TEFC	3600
100	*Westg.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	*Westg.	CS-760D	1200
100	G.E.	KT-553	1200

D. C. MOTORS

H.P.	MAKE	TYPE	SPEED
250	Westg.	SK-220	450/600
200	Reliance (2)	1400T	350/1200
200	Westg.	SK-201	650
200	Cr. Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1600
50	Cr. Wh.	CMC	700/1100
35	Westg. (2)	SK150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E. (2)	CD-123	400/1600
30/40	G.E.	CD-115	500/1500
25/30	G.E. (2)	RF-12	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000

M.G. SETS

K.W.	MAKE	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12000	600
500	Westg.	2300	125/250
400	A.C.	2300	120/240
300	Westg.	2300/440	250
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
125	Cr. Wh. (3)	4160	125
100	G.E.	2300	250
100	Al-Ch.	2300	250
100	Elec. Mch.	440	125

CHICAGO *Electric Co.* 1320 WEST CERMAK RD., CHICAGO 8, ILL.

BOILER FEED PUMPS

STEAM TURBINE DRIVEN

GPM	TFH	Stage	Mfg.
450	892	4	Worth. (2)
500	850	4	Worth.
200	1375	6	Ingersoll R. (2)
200	850	2	Weinman (2)
190	1320	4	De Laval
750	725	4	Worth. (2)

MOTOR DRIVEN

GPM	TFH	Stage	Mfg.
740	2250	5	Worth.
700	1550	6	Worth.
675	1100	5	LeCourtenay
500	1050	5	Worth. (3)
100	1150	5	Gould

UNDERWRITERS FIRE PUMP

GPM	TFH	Stage	Mfg.
1500	231	1 (motor driven)	Fairbanks
750	231	(gas. driven)	Allis Chal. (2)

MOTOR DRIVEN SAND PUMPS

American Manganese 10"
Allen-Shaffer-Hoff 14"

NASH HYTOR COMPRESSORS

(4) size #2, 850 R.P.M., 10# pressure, 240 C.F.M.; 860 R.P.M., 180 C.F.M., when used as a Vacuum Pump.

2—2800 Gal. cap. 100# steam press. hot water storage heaters, mfg. by Quaker City Iron Works. Good shape.

This is only a partial listing of pumps carried in stock. We have hundreds of other pumps, compressors, and power equipment. Don't ask us what we have, write and tell us what you want.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	2300	Whse.	450
300	4000/2300	G.E.	720
300	440	G.E. (hoist)	600
300	440	Whse.	2400
250	2200/440	G.E.	1200
250	440/220	Whse.	600
250	550/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	440/220	Whse.	514
200	2200/440	G.E.	600
150	440/220	Whse.	720
150	2300/440	G.E.	600
125	2300	G.E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/460	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
350	440	G.E.	KT	1200
300(2)	2300	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
250	2300	Whse.	CS	600
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
150	2300	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2300/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200

A. C. GENERATORS

1—320 kva, 600 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm, 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit, 3P. 25 KV outdoor
1—400 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
150	230	El. Dyn.	B/brg.	600
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
75	Cr. Wh. (unused)	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1— 600 kva, Standard, 13,800—2300 V., 3 ph.
3— 500 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 2400—480 V.
2— 300 kva, G.E., 4150—240 V., 2 ph., Pyr.
3— 200 kva, G.E., 2400—120/240 V.
3— 200 kva, Mol., 13,800—2300 V.
3— 150 kva, Al. Ch., 2400—220 V.
3— 150 kva, Al. Ch., 440-220 V., dry, New
3— 100 kva, Al. Ch., 440-220/110 V., dry, New

only partial listing

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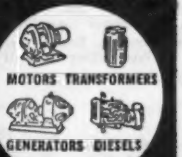
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

WORLD'S LARGEST INVENTORY
NEW AND GUARANTEED REBUILT EQUIPMENT



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ELECTRIC EQUIPMENT CO.
L. D. (Long Distance) 65
ROCHESTER 1, NEW YORK
Explosion Proof Motor Headquarters

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—1000 KW—240 volts—130/250# Condensing Auto. Extraction—13#—New 1945
1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#
1— 400 KW—550 volts—400# Condensing Auto. Extraction—20/50# New 1948
1— 300 KW—480 volts—210# Condensing Auto. Extraction—40#
1— 250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

3— 8,333 KVA—66,000/34,000/11,900/6900 volts
3— 500 KVA—2300/550 Volts (New 1948)
1— 450 KVA—13,800/208 Volts—3 ph.—(network)

HEATER

1—120,000# Desuperating Heater—Tray Type

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass:

THE BUYERS MUST BE SATISFIED—ALWAYS

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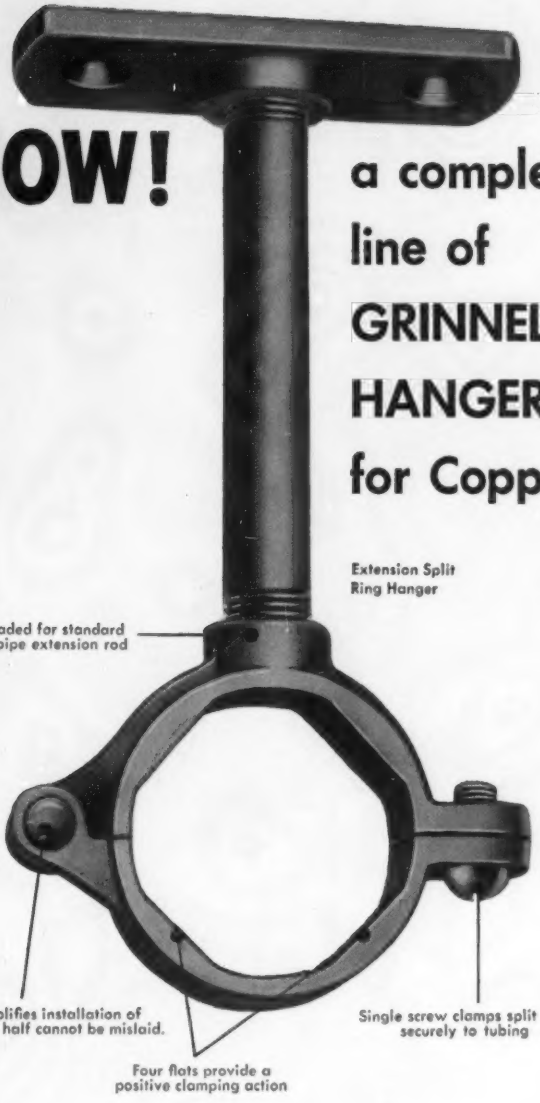
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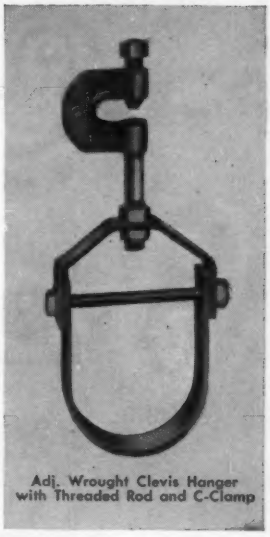
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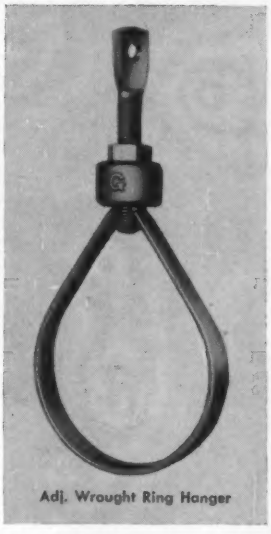
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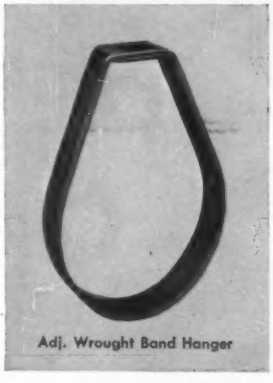
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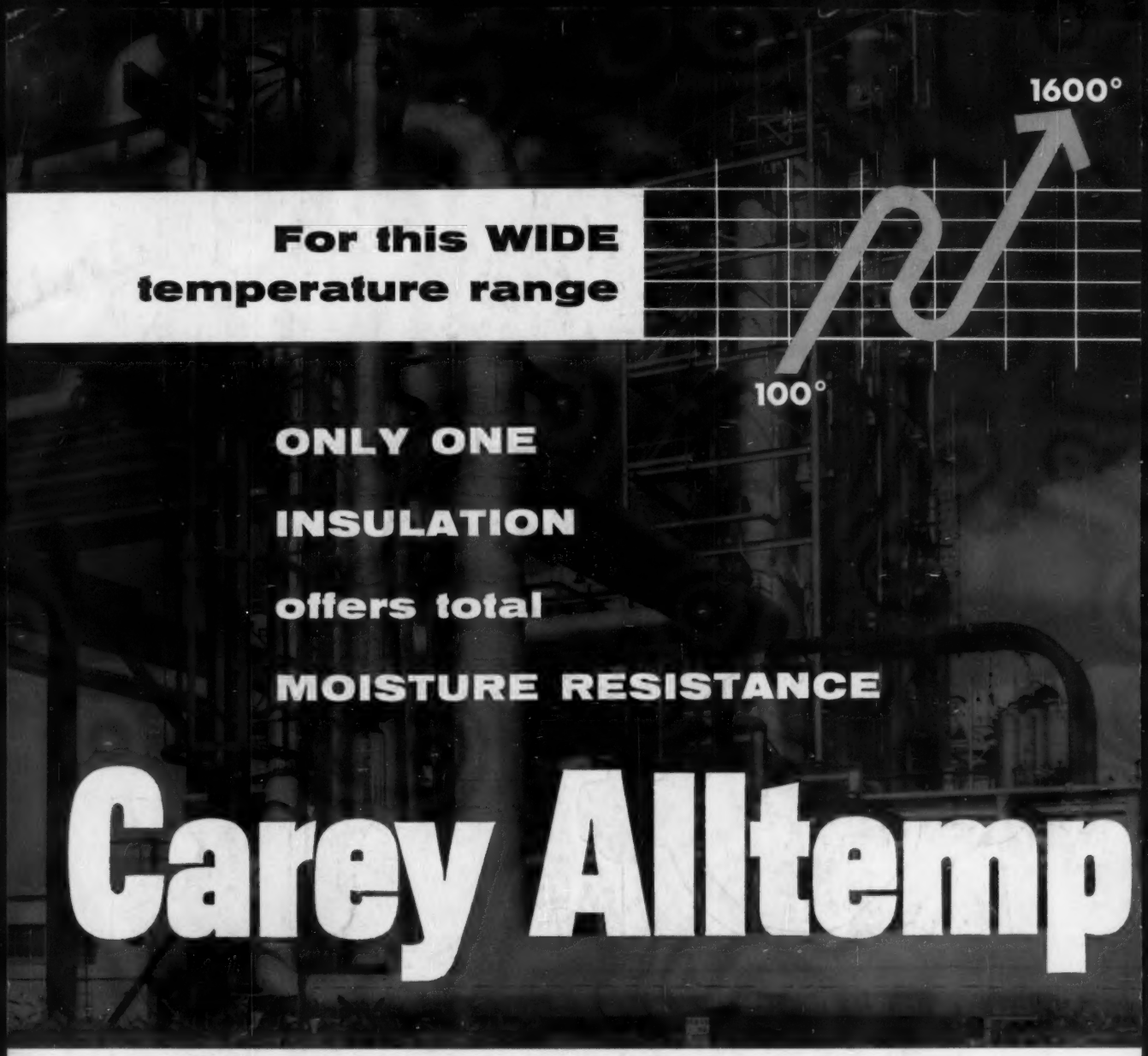

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